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Bus Stop Attributes and Perception of Safety
Case Study Huston Tillotson University

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Bus Stop Attributes and Perception of Safety
Case Study Huston Tillotson University

by

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Report

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Dedication

To my mother Delia

You are my source of encouragement and inspiration

You are my source of ambition and perseverance

Only you can make incredible things happen

My success belongs to you.

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"Si el presente es de lucha, el futuro es nuestro"

Ernesto "Che" Guevara

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Abstract

Bus Stop Attributes and Perception of Safety
Case Study Huston Tillotson University

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This professional report examines the degree to which the perception of safety shapes travel behavior in Austin, Texas, using Huston Tillotson University (HT) students as our case study. Focus groups are used to explore and identify what elements of the public transit experience are considered safe and unsafe. The report explores what "frightens" HT participants away from using the bus. A quantitative study is then used to measure environmental variables and their relation to bus stops and perceptions of safety. Austin crime data are used to locate bus stop crimes and develop a real context for bus riders' perceptions of crime. After describing the conditions of bus stops based on physical, environmental, and criminal attributes, the study develops scenarios based on safety characteristics for the study areas. This report closes by summarizing the empirical findings and gives design and policy recommendations for transportation planners, agencies, and policy makers.

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INTRODUCTION

The fear of crime and perception of safety can influence travel behavior (Sherman, Gartin, & Buerger 1998; Angel 1968; Loukaiatou-Sideris 1999; Wilcox, Quiesenberry & Cabrera 2004). For those that use or have used public buses as a primary mode of transportation, the perception of safety is subject to the conditions of the built environment at the bus stop and surrounding areas. Crime is a significant element since certain characteristics in the built environment can lead to higher or lower crime rates. Thus, characteristics of the built environment and the context of crime can shape the perceptions of safety (Sherman, Gartin, & Buerger 1998; Loukaiatou-Sideris 1999, 2000, 2001, ; Wilcox, Quiesenberry & Cabrera 2004). A lack of security at bus stops, or the perception of a lack of security, has pushed many to rely on private vehicles. The use of private vehicles as a safe and reliable transportation method puts a strain on budgets for minorities, and the lack of a private vehicle can be an impediment to social and economic opportunity. For those in disenfranchised communities or economically impoverished communities, the availability of transportation is limited and so are their opportunities. When analyzing transportation, it is important to consider the function it plays as a tool for economic development and opportunity (Liggett, Loukaitou-Sideris,& Iseki 2001)

In a series of focus groups and surveys designed by Dr. Talia McCray and Dr. Paul Anaejonu, data revealed that Houston Tillotson (HT) University students generally use private vehicles as their primary mode of transportation (n=62, 90%). It is important to acknowledge that Houston-Tillotson University is a member of the Historically Black Colleges and Universities (HBCUs), and thus the majority of HT students are considered part of the African American ethnic minority group of Austin. Frequent studies have captured the socioeconomic variations of minority groups engaged in urban travel, and these data reveal an increasing demand for public transportation services. Socioeconomic variations include factors such as income, education, race, ethnicity, and historical

economic trends. This social approach, aims to indentify the relationship between socioeconomic variations and the use of transit (Bullard, Johnson & Torres 2000; Liggett, Loukaitaou-Sideris & Iseki 2001; Sanchez & Brenman 2002; Litman 2007; Contrino & McGuckin 2009). However, few studies have addressed the role of safety, and its perception, in determining travel behavior and transportation mode selection for minorities. Mainstream data tend to place minorities within the public transportation box because of their statistically significant economic limitations (Sanchez & Brenman 2002; Holzer, Quigley & Rafael 2003; Litman 2007; Ward & Hill 2008). This fails to address the role of safety in their transportation mode selection. This methodological gap prevents researchers from adequately answering questions like: 1) Why do students prefer their private vehicles over public transportation? 2) What frightens HT students away from using the bus? 3) How does the perception of safety, as it relates to public transportation, influence their travel behavior? And 4) what defines a safe or unsafe public place?

OVERVIEW OF THE STUDY

This study is designed to analyze the degree to which the perception of safety shapes travel behavior and influences bus riders' decisions to ride or not ride the bus. Huston Tillotson University was the site where we gathered our data from the sample population. The study assumes that bus stop conditions can be defined by merging both physical characteristics and environmental attributes. In this study, focus groups are used to explore and identify what is considered safe and unsafe in public transportation. HT data are also useful in determining what environmental attributes are more influential on their perception of safety. Quantitative analyses, in the form of frequency analyses, correlation matrices, and a cluster analysis, are used to measure environmental variables and to develop a general scenario of the bus stops' micro and macro environment. In particular, the cluster analysis is helpful in identifying categories of bus stops. This is an important exercise that helps capture the natural attributes of some bus stops, summarize the data, and develop prototypes of bus stop that can be related to specific locations and land uses. Land Use data are used to describe the areas surrounding bus stops, define the

development trends in the vicinity, and contextualize some of the comments related to the perception of safety made by HT participants. Austin crime data are used at study locations to define types of crimes and their proportions around bus stops. Ultimately, crime data are used to give a context of crime when referring to the perception of safety, land use, and these bus stops' conditions. The crime data complements the creation of scenarios when determining how the evaluated bus stops look , why there are perceived as safe/unsafe, and what attributes and land uses are more related to crime.

The study does not attempt to draw conclusions about which environmental attributes raise or decrease bus stop crime. Also, the study does not attempt to draw conclusions on whether perceptions and environmental attributes are a "cause" or "result" of a crime rates. The study attempts to answer the questions: what frightens HT students away from using public transportation and are HT perceptions of safety based on an actual crime context? If HT students were to use the buses around their areas of activities, would the bus stops be classified as safe waiting places given the design structure and the conditions of the surrounding built environment? Ultimately, the study can be used as a guide for policy makers when looking at bus stops and their micro and macro environment, and how this affects individual's perception of safety in these areas.

SIGNIFICANCE AND IMPLICATIONS OF THE STUDY

The analysis of bus stop conditions, bus stop crime, and perception of safety is an important exercise to assess the needs of future bus riders, develop mechanism to attract users, and offer a service that will be both safe and comfortable. Understanding what individuals define as safe and unsafe is important to designing and locating bus stops. Paying attention to these issues provides transportation planners with a clear idea of what design principles should be prioritized and which locations are considered suitable based on safety requisites.

By acknowledging the role that perceptions of safety play in transportation planning, decision makers can shape their policies and provide better services for bus riders. In

addition, improving the bus system can increase the demand for the service by attracting users. Improving the services can generate better access to opportunities for transit dependents. For those who rely on a private vehicle, improving the system may create opportunities to reduce commuting costs, vehicle costs, and traffic congestion.

Paper Outline

This report begins by describing the literature review, data collection instruments, methods, and a description of the study group and study locations. A qualitative analysis is used to understand what is considered safe and unsafe in the built environment. This is done through focus groups and surveys with HT students. An evaluation of bus stops is based on a survey of the surrounding bus stop environment, which is analyzed in SPSS to look for frequency, correlation, and clusters. Bus Stop Crime is evaluated using 2009 Austin Police Department Crime Rates. These data are merged geospatially with bus stop locations and land uses, using the geographic information system (GIS) ArcGIS 9.3. The paper concludes by discussing the findings and how they are related to the main research questions, the implications of these findings on travel behavior, and recommendations to transportation agencies on how to improve the services base on safety concerns.

Chapter One: Literature Review

The perception of safety affects all aspects of human activities and it is intrinsically related to crime in the built environment. Angel (1968) was among the first researchers that framed and developed the bridge between crime and the built environment – both physical and social – by analyzing how urban physical planning and design can assist in discouraging crime. Angel discusses the existence of "Critical Intensity Zones" which he defines as areas where pedestrian circulation is intermediate (Angel 1968). Intermediate circulation refers to areas that have enough potential crime victims but not enough as to provide an adequate surveillance function. As intensity of use increases and streets become more populated, they become safe again (Angel 1968). These zones tend to have specific physical environmental characteristics and land uses that provide opportunities for delinquents to commit a criminal offense; creating a perfect setting conducive to criminal mischief. Some examples are: open parking lots in isolated areas, commercial areas backing residential areas, structures that provide poor pedestrian circulation, flexible zoning ordinances, and un-centralized evening establishments (Loukaitou-Sideris 1999). Despite the wide application of his proposal, Angel's research seems to lack a discussion of the common physical elements of cities that also serve as crime deterrents,like lighting, fences, building façades, surveillance cameras, alarms, etc. Among his assumptions, he does not consider crime against property a catalyst for crime against citizens. He frames crime only at intermediate levels of pedestrian traffic, and in his list of visible pedestrian public places he does not include bus stops or transportation hubs.[1]

Consistent with Angel's proposal, Wilson and Kelling (1982) also analyzed crime in the built environment. However, their research focused on role of police as crime-

[1] "The data suggest that passengers in moving vehicles are rather well protected against this class of offenses, unless they happen to be taxi drivers or bus drivers who are being robbed by passengers. Our study is directed to those public areas where pedestrians circulate." (Angel 1968:7) Perhaps, the main assumption is to consider bus drivers as the only victims of robbery by passengers and not include bus stop and transportation hubs as public pedestrian areas.

fighters and how they can strengthen the informal social-control mechanisms in order to minimize fear in public spaces. Along those lines, they first put forth in 1982 the "Broken Window Theory" which is an analogy to illustrate how the condition of the built environment influences crime and the fear of crime. The broken window theory suggests that serious street crime will happen in areas where disorder is unchecked. In this case, "one broken window becomes many" and unattended areas send the social signal that "no one cares"(Wilson & Kelling 1982:5). Thus, "muggers and robbers, believe they reduce their chances of being caught or even identified if they operate on streets where potential victims are already intimidated by prevailing conditions" (Wilson & Kelling 1982:5). According to Wilson and Kelling, a well-maintained built environment will decrease minor crimes and criminal behavior. Thus, major crimes will be prevented. In their definition of the built environment, bus stops are included; however, they are not the primary focus.

Influenced by the studies of Angel and Wilson & Kelling, Anastasia Loukaitou-Sideris (1999) was among the first researchers that studied crime at a specific urban setting – the bus stop – and the perception of safety therein. She concluded that the fear of crime does influence how people live their lives and travel.[2] Loukaitou-Sideris' study, based on empirical observations and survey research, argues that there are several environmental factors that might create opportunities for crime at bus stops since bus stops often lack facilities that deter it (Loukaitou-Sideris 1999). These environmental attributes can be eliminated through changes in design. Loukaitou-Sideris states that: "*the limited number of sites and situations constitute the loci for the vast majority of offenses and the concept of place seems central when the characteristics of the place affect the probabilities of crime"* (1999:397-398). Loukaitou-Sideris utilized Wilson & Kelling's "Broken Window Theory" to indicate that many high-crime bus stops are full of "broken windows, literally and metaphorically". She concludes with a list of negative

[2] Leavitt, J. & Loukaitou-Sideris, A. (1995). A decent home and a suitable environment: dilemmas of public housing residents in Los Angeles. Journal *of Planning Education and Research, 12 (3), 221-239.* Introduction of the term "Transit crime" as crime on buses or train, or at bus stops or trail stations.

environmental attributes that are considered “crime generators” (Loukaitou-Sideris 1999:398). Examples of such crime generators are: abandoned commercial and industrial structures, broken benches, cracked sidewalks, uncollected trash and litter, poor lighting, easy escape routes, liquor stores, pawn shops, pool halls, and vacant lots.

In 2001, following her initial research, Loukaitou-Sideris conducted a spatial analysis to measure the effects that urban forms (land use) and bus stop characteristics have on crime rates (Liggett, Loukaitou-Sideris & Iseki 2001). Using GIS, she was able merge crime data and negative environmental attributes (visibility, litter, and liquor stores).She standardized the results by crime per bus rider. She found that areas with high crime rates share similar physical characteristics and attributes that can explain crime incidents. In this case, “most bus stop crimes tend to be in dangerous places”, which often have negative environmental attributes and poorly designed structures (Liggett, Loukaitou-Sideris & Iseki 2001). To weigh her results Loukaitou-Sideris developed two regression models, each with separate spatial correlations. The regression analysis calculated the effects of environmental factors on the crime and uses crime per rider as the analysis unit. The regression formulas were unable to provide strong R-square coefficients to truly localize high crime clusters in specific corridors. Therefore, there was not a strong correlation between crime and specific environmental attributes. “Only one location variable contributed significantly to the regression model” (Liggett, Loukaitou-Sideris & Iseki 2001). In her research, Loukaitou-Sideris does not measure the effect that the perception of safety at bus stops has over travel behavior, neither had she correlated variables to identify a pattern or cluster categories.

In understanding perceptions of safety, Austin & Buzawa (1984), Ingalls & Owens (1994), and Needle & Cobb (1997), have concluded that “fear and anxiety about personal security are important detractors from using public buses”; causing people to avoid specific transit routes, buses, or to not use public transit at all (Loukaitou-Sideris 2005:2). Also, the British Department of Transport in 2002 developed a report on people’s perception of security and their concerns about crime on public transport. The report concluded that personal security is a major barrier to the use of public transport.

The report discussed the causes of these fears and whether they stem from actual incidents of crime or from the attributes of the built environment of transportation locations, like bus stops. In an innovative approach which uses qualitative and quantitative data, the report discuses physical attributes and locations while evaluating perceptions of safety or fear of crime. This approach worked to develop a dynamic analytical method that took into account risk and a physical location (place and community). Results revealed that security concerns are more related to, and measurable, in terms of the physical environment the subject is in than the actual risk of a crime occurring. In defining "kind of place" or location, the report takes a deeper look into the physical attributes of bus stops and the built environment.

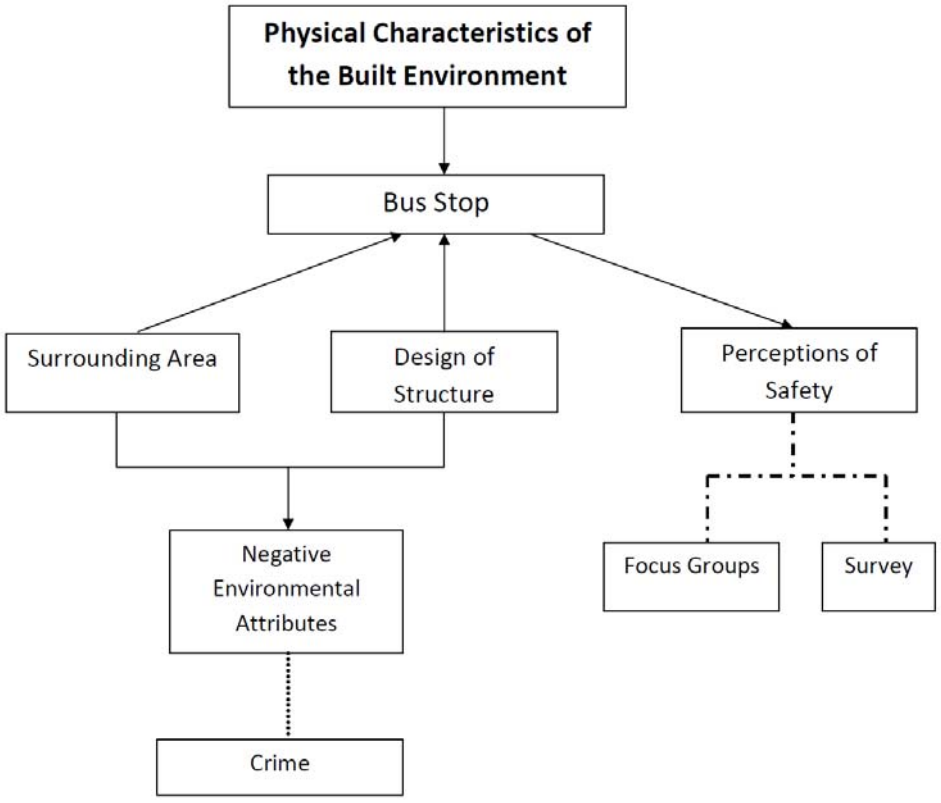
In addition, the report makes the argument that negative environmental attributes influence perceptions. When understanding the risk of a crime, the fear of being the victim of a property crime weighs more than being victim of a personal crime (British Department of Transport 2002). In addition, the report compared minority groups (Asian and Blacks) with the white population to conclude that the perception of security on public transport is generally the same for all groups. A caveat of this report is that it had certain limitations to the gathering of highly detailed crimes statistics such as percentage of crime by locations, and types of crime by locations.

In a follow up study to the one developed by the British Department of Transport, Loukaitou-Sideris (2008) conducted her own study of transit riders' fear of crime. Specifically, her research looked into women's fear of victimization in bus transit. Her findings provide empirical evidence that women have different safety and security needs than men. This illuminates a "mismatch in the types and locations and strategies transit agencies use" when addressing safety needs (Loukaitou-Sideris 2008:573). Loukaitou-Sideris pointed out the general "ambiguity among transit operations" regarding security features for female passengers (Loukaitou-Sideris 2008:573). However, her research didn't include statistical data to measure this mismatch or the perception of incidents as they relate to safety and the resultant influence on travel behavior and potential policy interventions.

CONCEPTUAL MODEL

Following Angel (1968), Wilson & Kelling (1982), Loukaitou-Sideris (1999, 2001 & 2008), and the British Department of Transport Report (2002), this study proposes a conceptual model (Figure 1). The model assumes that at a bus stop location, the perception of safety, its surrounding area, and the design of the bus stop itself are key to understanding the overall condition of the built environment. It also was developed to provide an accurate evaluation of the negative environmental attributes that, according to the above discussed literature, create conditions for crime to occur. This conceptual model provides a framework to analyze how one's perception of safety influences an individual's travel behavior and transportation modal choice. This framework will be applied to the survey of HT students to determine their perception of safety, its relation to their travel behavior, and reasons for preferring private-owned vehicles over public transportation. Focus Groups and Survey data are used to understand and define perceptions of safety.

Figure 1: Conceptual Model



Understanding the Conceptual Model

The conceptual model considers the physical characteristics of the built environment as the common point and follows the line of researchers such as Sherman, Gartin & Buerger (1989), Angel (1968), Loukaitaou-Sideris (1999, 2001, & 2008), Wilson & Kelling (1982), and Wilcox, Quiesenberry & Cabrera (2004). Researchers agree that specific physical characteristics of the built environment can be conducive to crime. Angel (1968) considers citizen surveillance an important crime deterrent and the lack of "eyes on the street" creates more crime potential. Wilson & Kelling (1982) and Wilcox, Quiesenberry & Cabrera (2004) emphasize the importance of positive physical attributes to prevent crime. Sherman, Gartin & Buerger (1989) and Loukaitou-Sideris (1999) highlighted the physical characteristics of hot spots or areas with high crime rate.

The primary focus of this study will be the bus stops identified by HT students and Capital Metro, the Austin transit agency, along routes liking home locations, Huston-Tillotson University, and activity sites. The general characteristics of bus stops and the surrounding area have been analyzed in-detail by Loukaitou-Sideris (1999) and to some extent by Sherman, Gartin & Buerger (1989). They agree that negative environmental attributes around bus stops increase bus stop crime rates. Moreover, they also consider that negative environmental attributes affect citizens' perceptions of safety.

Regarding perceptions of safety, the literature reveals that sometimes perceptions are not related to actual experiences with crime or the physical crime context (Wilson & Kelling 1982; Loukaitou-Sideris 1999). However, one's perception of safety is a powerful psychological factor that can limit the mobility of transit users and even deter them from using the transit services at all. The perception of safety is an abstract concept that is usually better understood through empirical evidence or qualitative data gathered from focus groups, surveys, and direct observation (Loukaitou-Sideris 2008, British Department of Transport 2002). Following these principles, the above conceptual framework applies the focus group and survey methodology to the Huston Tillotson University students' case study. This is done to develop a general understanding of what

students consider safe and unsafe while riding, or waiting for the bus, and whether these safety issues influence their transportation modal choice. “Perception” for this research is understood in terms of positive or negative environmental attributes at the bus stops and surrounding areas.

When considering a bus stop’s microenvironment, literature suggests that less attention has been given to the design of bus stops and how that design may influence one’s perception of safety (Loukaitou-Sideris 1999; Wilcox, Quiesenberry & Cabrera 2004). Bus stops are usually designed and analyzed in terms of ADA compliance by following regulations of the American with Disability Act of 1990. Hosen’s research (2006) entitled *Transit Agency Participation in Medicaid Transportation Program* details ADA transportation parameters. Other than ADA, bus stop designs do not commonly take into account personal safety. Loukatoui-Sideris (2001), briefly introduces the links between the physical design of bus stops and perception of safety by analyzing the significance of bus stop shelters over bus stop crime rates. However, the subject of actual physical design is not the focus of her research. Our study goes a step further by analyzing bus stops structures using elements of Hosen’s survey to identity negative or positive environmental attributes shaping bus stop microenvironments. The design of the bus stops, along with their positive and negative attributes, is then linked to the crime rates within each bus stop microenvironment.

The research and conceptual model offer a unique perspective on the influence of bus stop design on the perception of personal safety by using focus group data to support findings and by also developing a cluster-correlation analysis of physical characteristics and negative environmental attributes. Thus, this model contributes to the determination of what prevents people from using public transportation and defines the degree of influence perceptions of safety have on travel behavior and the use of public transit.

Chapter Two: Methodology

STUDY SAMPLE AND PERCEPTION OF SAFETY

Data Collection

The study was carried out through four focus groups of Huston-Tillotson University students, faculty and staff. Sixty-nine (69) persons participated in the focus groups. Approximately 90% of the participants were students, and the remaining 10% were faculty and staff members. The focus groups and surveys were designed by Dr. Talia McCray, a professor at UT Austin in the Community and Regional Planning Program, and Dr. Paul Anaejonu, a professor at HT in the Political Science Department. Capital Metro employees in the Community Involvement Section and six UT Community and Regional Planning Graduate students volunteered to support the design and implementation of the focus groups.

Each of the four focus groups met separately for a total of four meetings of approximately 2 hrs long. During that time, four data collection instruments were put into practice to gather information on what HT participants consider “safe” and “unsafe” in the built environment. These instruments were:

1. A long survey with close ended questions administered to approximately 200 persons including focus group participants. The survey explored some travel behavior patterns, areas of activities, safety concerns, and demographic information.
2. A perceived safety short survey. The survey addressed the perception of safety and safety concerns linked to whether or not the respondent had been physically attack.
3. Focus group post-it notes. The post-it notes were used during the focus group discussions to record specific reactions to questions made by the moderators such

as: difficulties in taking public transportation, and benefits of changing daily commuting patterns.

4. Focus group transcripts from UT note-takers. Transcripts of all the meetings were recorded for use and analysis. *Table 1 presents the data collection instruments in detail.*

Table 1: Focus Groups Data Collection Instruments

Long Survey The long survey was administered to approximately 200 persons including focus group participants. Survey topics: - Travel behavior - Areas of activities - Safety concerns - Demographic information
Perceived Safety Short Survey Questions: - Male/Female? - Have you ever been physically attacked? - Do you know of any family members or friends who have been physically attacked? - What sorts of things in the built environment communicate a sense of security? - What sorts of things in the built environment cause you to feel insecure/unsafe? -
Post-it Notes Specific questions posed by the moderator and recorded on post-it notes by the focus group participants: - What difficulties do you have in taking public transportation? - What benefits do you see in changing your daily commuting patterns? - What would it take for you to leave your car at home and travel via another mode? What changes would you have to make in your life? What changes would you like to see Capital Metro make? Would you consider carpooling to work? - What image does the city's bus service convey in your mind? Is it cool to ride or just for certain types of folks? Is it just for people who don't have cars? Is it safe?
Focus Groups Transcripts Notes Questions posed to guide focus group discussions: - What types of things do you typically do on a regular basis? - How do you typically access your activities? - Do you use public transit? - What types of activities do you access via bus? - What difficulties do you have in taking public transit? - Do you know where the nearest bus stop is to your Home? - What would it take for you to leave your car at home and travel via another mode? - What benefits do you see in changing the patterns of your daily travel to and from work and school? - If commuter rail serviced your community, would you use it? - What image does the city's bus service convey in your mind? - Do you have as much safety concern waiting for the bus as you have walking to and from the bus stop? - Do you believe there is a gender difference in perceptions of safety? Explain. What fun places would you like bus access to?

Method of Analysis

To understand what HT subjects consider safe and unsafe in the built environment and the importance they give to some of these elements, a qualitative analysis of the transcripts, post-it notes, and surveys was conducted. In this study, two methods were used to analyze qualitative data: MS Excel and Atlas-TI. These methods were selected because they allow a flexible interpretation of the qualitative data and they are user-friendly. Excel is useful in analyzing both words and numbers. It allows the research to track words, assign numerical values, and relate numerical values to words, themes, or categories. Using simple tabulation principles, it helps to count and search the frequency a topic occurs and keep track of how many respondents highlight different themes. Also, it is useful in creating graphs and tables to illustrate tabulation and frequency results. On the other hand, ATLAS-TI systematically analyzes complex data hidden in text, audio, multimedia and geodata. Atlas-TI software allows users to code, locate and annotate findings of primary data and evaluate their importance, look for frequencies, and visualize the relations through network connections.

MS Excel Analysis

MS Excel was used to identify topics related to perceptions of safety and to calculate how many comments were made while subjects were addressing those topics. The comments recorded in Excel described what HT participants consider safe and unsafe about the built environment around the bus stops and about the actual bus stops. First, a matrix was created with the most common topics gathered from the focus group transcripts and post-it notes. Then, the perceived safety short survey was used to relate comments and participants to the topics. Table 2 shows the formulas used to calculate comments by participants and by topics.

Table 2: Calculations / Formula

Step 1	Determine the N value or total number of participants for all focus groups
Step 2	Locate topics under the categories of perceptions of security and insecurity using transcript and post-it notes as references.
Step 3	In each focus group, create an individual worksheet. Then, using the perceived safety short survey, quantify the number of comments made by each participant and place those comments under its related topic.
Step 4	Calculate the total amount of comments by topic for both categories, perceptions of security and insecurity.
Step 5	Calculate the percentage of comments by topic for the two categories. i. Total the amount of comments in each category ii. Then, apply the next formula: (Topic total comments/ grand total comments)*100%
Step 6	Calculate the percent of comments by topic and total of participants in each focus group iii. The calculations are based on proportion, thus the 100% rule does not apply. iv. Apply the following formula: (number of comments in each topic/total of participants in each focus group) v. Apply the following formula to calculate the average of comments: (total comments for category/total of participant in each focus group)

To visualize the results, pie charts and bar graphs were created for each Focus Group. The pie charts show the percentage of comments by topic. The bar graphs show the percentage of participants that commented on that topic, considering that each participant made one or more comments per topic. Together, the charts and graphs explain what focus group participants consider safe and unsafe in the built environment. *Summary of the topics and calculations can be found in Appendix A.*

Atlas-TI

In this study, Atlas-TI was used to calculate the frequency or number of times specific words were utilized to describe perceptions of safety. Also, it was used to display

graphically the connection of words to the concept of perceptions. This method complements the MSExcel analysis in determining what focus group participants consider safe and unsafe in the built environment. It also highlights the relevance participants give to some words (concepts) when describing their perceptions. It gives evidence when answering the question: what do HT participants consider most important with regards to safety.

To conduct the frequency and word connection analysis, data from the focus group surveys, post-it notes, and transcripts were separated into independent MSword files. These files were then exported into Atlas-TI. The words used in the frequency and word connection analysis are the top three topics for perception of security and insecurity identified in the MS Excel analysis. However, "Hot Spots" (3rd in the perception insecurity analysis) was replaced with "a poor-built environment" because HT participants often define and relate hot spots to the condition of the built environment (vandalized, turn-down, dirty, etc). The word relation criteria used to define the words in Atlas-TI are presented in table 3.

Table 3: Words Relations

Police	Police; patrol; patrolling; policemen; policeman; guard; officer; enforcement
Lighting	Lighting; light; streetlight; lamps; lit; illumination; visible; visibility; open_area+areas.
Built Environment	Good_environment; friendly_environment; clean; beautiful_environment.
Isolated Dark Areas	Dark; low_lit; dim; isolated; far; distant; deserted; solitarily; darkness, obscure; isolate.
Suspicious People	Homeless;drunk;drunks;drug;dealers;addicts;prostitutes;crackhead; crackheads; whores; violent; gangs; weirdos; weird; crazy; crazies
Poor Built Environment	Filthy; dirty; moldy; broken; damp; abandoned;

To determine the frequency of specific words associated with perception of safety, ATLAS-TI gives five types of coding techniques: open coding, code-by-list, in-vivo coding, auto-coding, and quick coding. After several tests, auto-coding allowed us to analyze multiple primary documents at the same time and to trace the relationship between the documents. Auto-coding not only produced frequencies but also created family groups. Family groups are the number of concepts or topics to which the word is related.

Atlas-TI generated an output report that gives the detail of the frequencies. Also, it produced a Network Connections Graph that helps visualize the relationship between words. *Illustration located in the results section.*

BUS STOP SURVEY

Data Collection

In 2008, as part of the *Easter Seals Project ACTION*, Austin based KHF Consulting Group developed a "*Toolkit for the Assessment of Bus Stops Accessibility and Safety"*. Transportation Planner Ken Hosen led the development of a *bus stop checklist or bus stop survey* as part of the toolkit. For the purpose of this study, the KHF bus stop checklist was used as a reference and revised and adjust to fit the needs of the study and the City of Austin. As a result, a new bus stop survey was developed that focused more on safety aspects of bus stops than on accessibility conditions. Loukaitou-Sideris' (1999) description of negative environmental attributes were also incorporated in the bus stop survey to enhance the analysis with a focus on safety perceptions.

The survey was divided into 1) Bus Stop Location and Transit Experience, and 2) Safety and Security Measures. Using this division, the bus stop survey assessed important components of infrastructure design such as shelter, seating, landing area, trash

cans, and lighting. Also, it targeted aspects of the surrounding area that are considered to be influential when understanding perceptions of safety such as: bus stop setting, traffic controls, traffic hazards, signage, landscaping, and environmental attributes. Using the newly revised bus stop survey as an instrument, data were collected on thirty-eight (38) bus stops within three study areas. *Complete bus stop survey located in appendix C*

To identify the thirty-eight (38) bus stops, an accessibility study was conducted. Myung Kyung Chung, research assistant at the UT Community and Regional Planning Program performed the accessibility study. Using HT focus group transcripts, post-it notes, surveys, and bus routes, bus stops and areas of activities were identified. Based on HT focus group data, a list of places and locations was produced and a bus route study was conducted to identify which buses HT students might use to reach their destinations. Out of this analysis, three areas of activities were identified:

- Downtown Area: from 12th Street to 2nd street, and from San Antonio to Red River.
- HT Area (location of Huston Tillotson University main campus): from 12th Street to 2nd street and from Chalmers to Pleasant Valley.
- East Riverside: from East Riverside to Oltorf and from Tinning Road to Crossing Place.

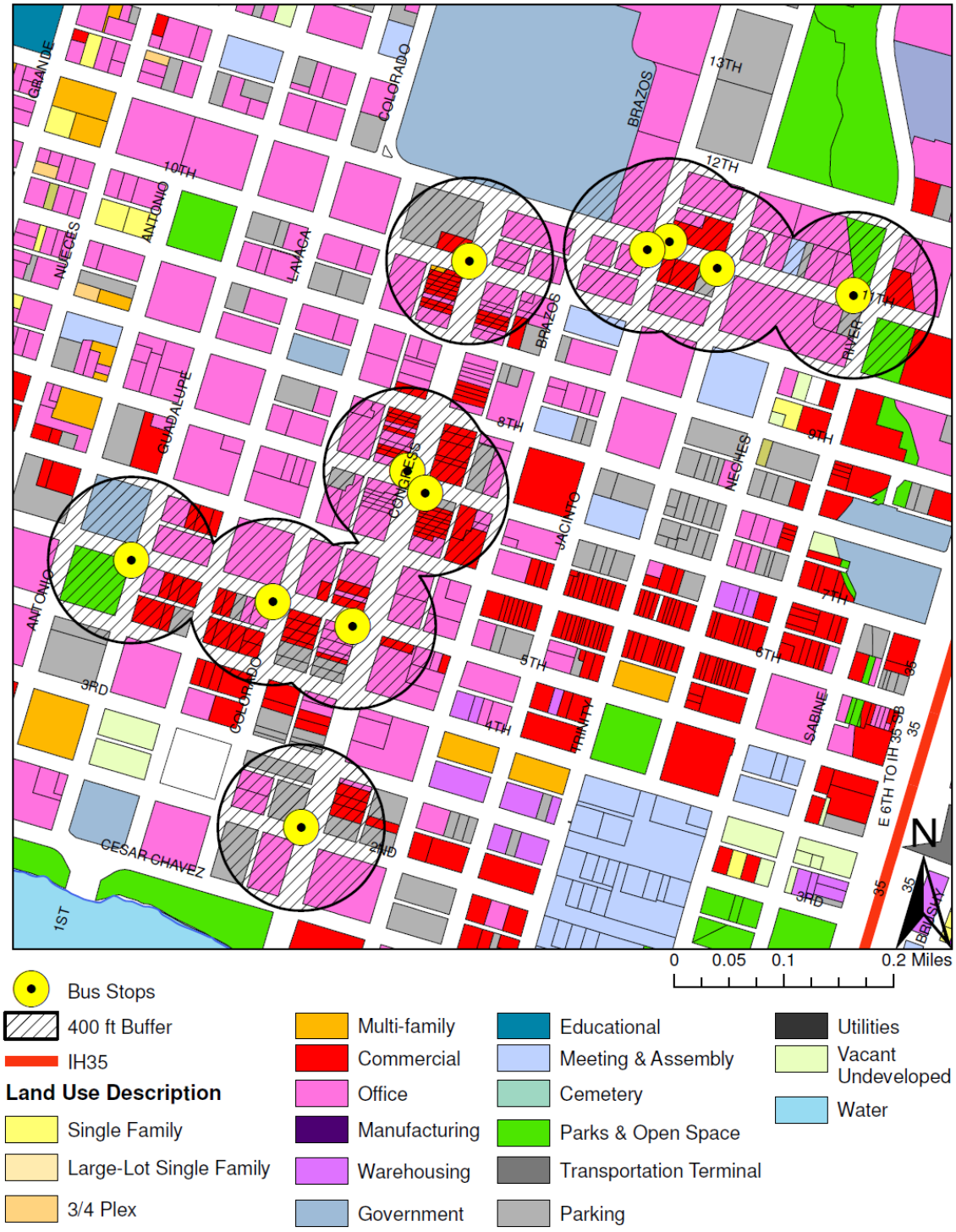
The three areas provide specific amenities for HT participants which make them attractive to students. For example, the two surveys, transcripts, and post-it notes identified Riverside as the area where most of the students reside. Downtown was identified as entertainment area, especially for nighttime activities, and the HT area was identified as the school study area, and also an after-school entertainment area.

Using walking time, bus routes, and proximity to identified destinations, the thirty-eight (38) bus stops were selected spread throughout the three activity areas. The bus stops were distributed as follows: eleven (11) bus stops in downtown, fifteen (15) bus stops in the HT area, and twelve (12) in the Riverside Area.

Since the bus stop survey included the analysis of the bus stops' surrounding area, a 400 foot buffer was applied to the defined bus stop boundaries. The calculation was then made using the average distance between two bus stops. According to data provided by Capital Metro, the average distance between two bus stops is 0.1 mile. Thus, the study assumes that between two bus stops, 0.05 miles is the space belonging to each one separately. 400 feet is approximately 0.05 miles.

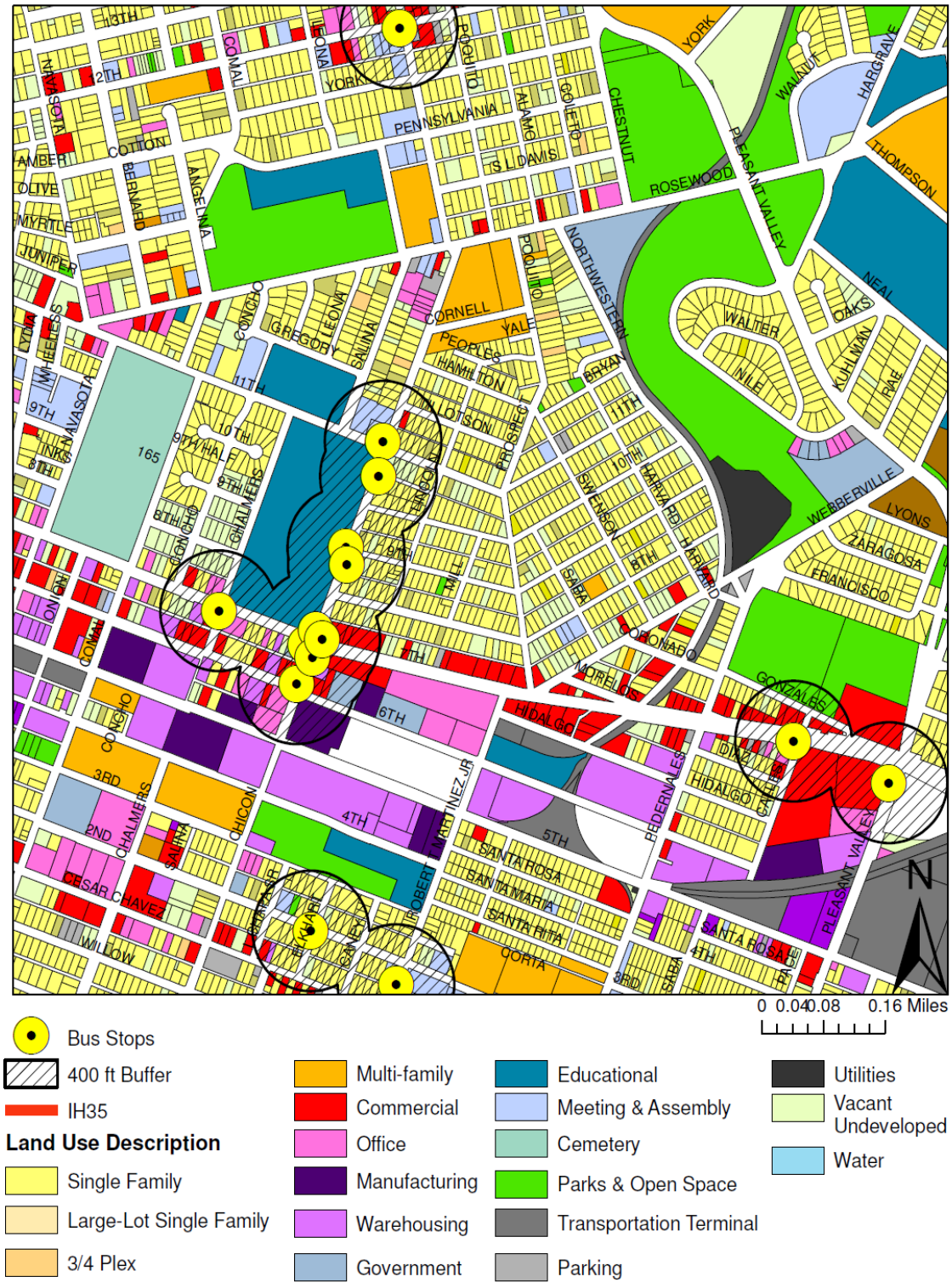
The maps of the three study areas define the land uses and development patterns that make each area unique. The downtown area is mainly composed of parking lots / garages, office buildings (both public and private), and a constant growing commercial zone. The HT area is characterized by single family houses and small developing offices and commercial zones along the 7th Street corridor. The East Riverside Area, in contrast, is distinguished by multi-family houses and apartment complexes, vacant lots, and a medium sized commercial districts around East Riverside Corridor. *Maps 1 to 3 show the Land Use Map and Bus Stop Locations*

Austin Downtown Area

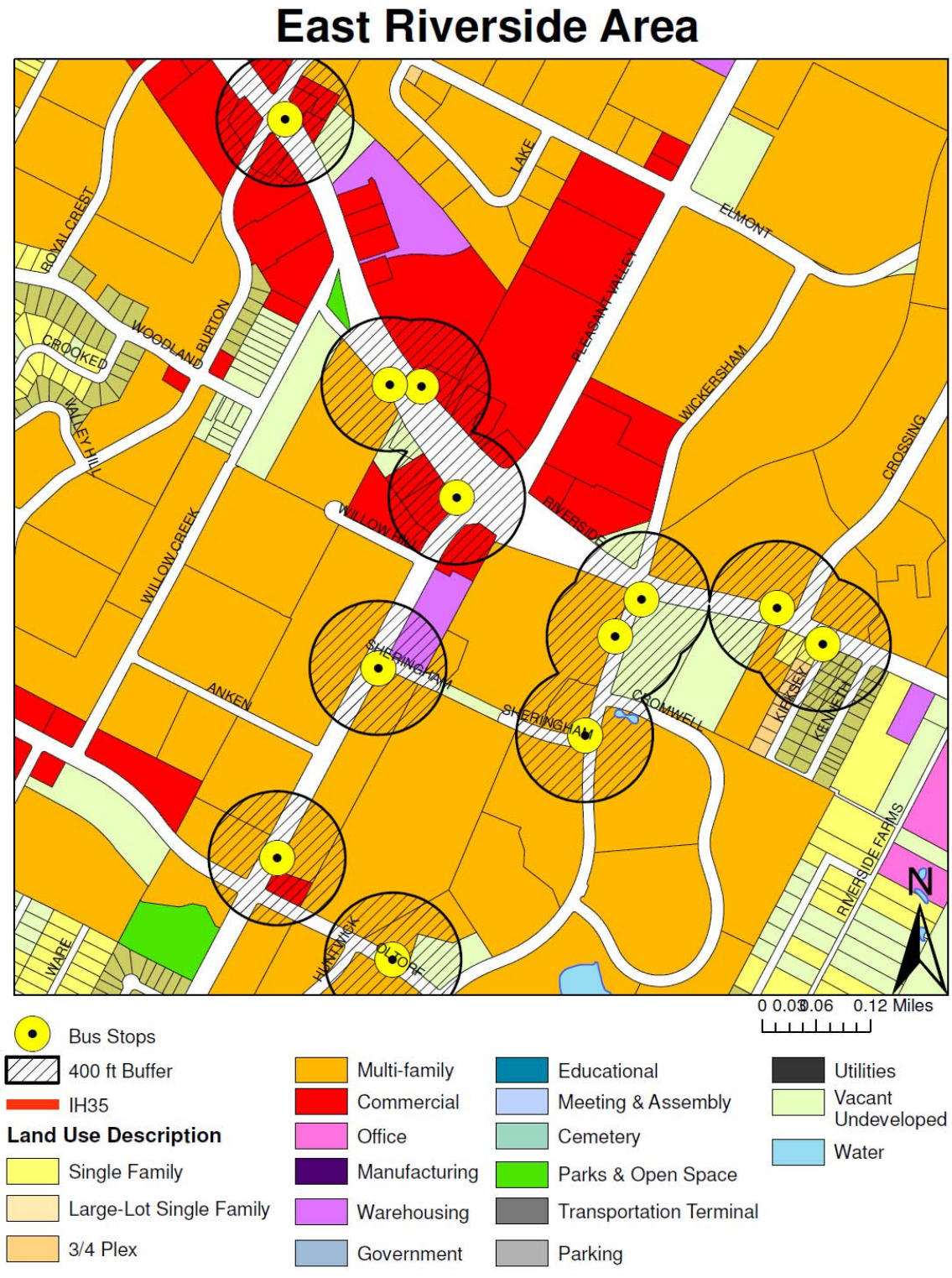


Map 1: **Downtown Land Use and Bus Stops Locations**

Huston Tillotson Area



Map 2: **HT Area Land Use and Bus Stops Locations**



Map 3: **Riverside Land Use and Bus Stops Locations**

Method of Analysis

The survey responses were processed in Excel using discrete categories of data having multiple choices and yes-no formats (1-0). Each bus stop was given a unique ID number, and matched with Capital Metro's bus stop IDs to determine the exact physical address. Once the data collection processing and recording was completed, all data were exported into SPSS. Using SPSS, a *frequency analysis* was developed. Also using SPSS, a *correlation analysis* and a *cluster analysis* were performed. Both of these will be described below.

A *frequency analysis* is used when finding out how often certain phenomenon occurs in a sample. In this case, how often are specific bus stop amenities found among the surveyed bus stops. The frequency analysis measures the central tendency of the data. It then determines the dispersion/distribution, of the variables around this central tendency. A *correlation analysis* is then used to measure the strength of the relationship between two variables solely based on the physical elements of bus stops and their negative attributes. Also, the correlation is used to determine if changes in the physical elements of bus stops are associated with changes in the negative attributes and vice versa. Finally, a *cluster analysis* was used to capture categories of bus stops by grouping the most significant variables (amenities). The results will have an effect on bus stops. In general terms, a cluster analysis is a "descriptive tool" that was chosen to give a rich, "meaningful representation" of how variables group together and to "make classifications" of bus stops (Romesburg 1984; Waits, Rex, & Melnick 1997). Based solely on variables ascribed to physical elements and negative attributes, the cluster can help determine the condition of bus stops and how bus stops look. Also, the categories/classifications can help identify prototypes of bus stops and related them to the study area and land uses, giving a general picture or scenario. Ultimately, the cluster analysis is a "tool for a method of inquiry" that identifies which variables are key on determining types of bus stops (Romesburg 1984).

Frequency Analysis

As technical criteria for the frequency analysis, all the category responses, or variables, were mutually exclusive and exhaustive. This means that the same observations cannot be counted twice or cannot belong to another variable. The construction of the frequency distribution involved the total number of observations, the number of responses that fall within each response category or variable, and accumulative frequencies to which a bus stop was identified with each variable. The frequency analysis helped in determining the condition of the bus stops surveyed, how they look, and how recurrently specific amenities are present.

Correlation Analysis

The Correlation analysis measured the strength of the relationship between negative attributes and physical elements of the bus stops. By looking at each of the variables individually, it weighed the strength of the linear association and hypothesized on the type of relationship. When the relationship is examined, the correlation determines to which extent changes in the value of physical attributes are associated with changes in the value of environmental attributes. The strength of the relationship is measured in terms of < or = to +/- 0.5. Thus, all the values within these boundaries are considered in the analysis. Since the study has a small sample, values that can be rounded to 0.5 are included in the study (reference).

The correlation analyses complement the frequency analysis by providing evidence on the degree of association of the variables. The correlation analyses cannot interpret cause-effect relationships. They merely measure the significance of the strength of variable associations. Ultimately, the correlation analyses also contribute to the creation of scenarios and to the general description of the surveyed bus stops.

Cluster Analysis

The cluster analysis aims to reveal natural groups and similar patterns (composition) between the physical elements of the bus stops and the negative attributes of the surrounding areas. The results determine types of bus stops using the physical conditions and negative attributes at bus stops as the main criteria to "standardize the data" (Romesburg 1984:4-5). Also, the results provide evidence to describe bus stops and their conditions. In simpler words, by grouping variables, the clusters will identify and describe categories/classifications of which negative attributes are commonly related to the different bus stop physical amenities (i.e. shelter, and seating).

Overall, the cluster analysis evaluates the variables individually and then as subsets so that similar variables are grouped and similar patterns identified. By viewing the patterns, different categories/classifications are developed. These groups describe how many bus stops share common elements and identify elements shared. Ultimately, the cluster analysis builds a bridge between physical elements and negative attributes to provide evidence of the different types of associations.

To design an accurate and rational cluster analysis, *The Multivariate Statistical Cluster Method* was applied using a *hierarchical cluster classification, K-Mean cluster recalculation, and a Discriminant Function for cluster optimization.* The hierarchical clustering method was chosen primarily because it not only allows "for pattern recognition and automatic classification, but also allows the researcher to determine the limits of the clusters" (Romesburg 1984). By offering this flexibility, the process can adapt the clustering technique to the research needs and use other elements of the analysis to rationalize the categories.

The distance measure which determines how similar two or more elements are in the cluster was calculated using the "hierarchical logic methodology" and presented in a "dendogram" (Romesburg 1984:3). In this sense, the hierarchical cluster allows the researchers to determine the distance measures by giving them several distance functions

to choose from such as: Euclidean distance, Maximum Norm, Mahalanobis Distances and Hamming distance among others. With these options, the researcher has the power to influence the shape of the cluster to fit the research needs. For this study, the Euclidean distance was chosen because it is the most common and ordinary distance measure given by the Pythagoras formula. Also, it is referred to as the geometric measure of two points.

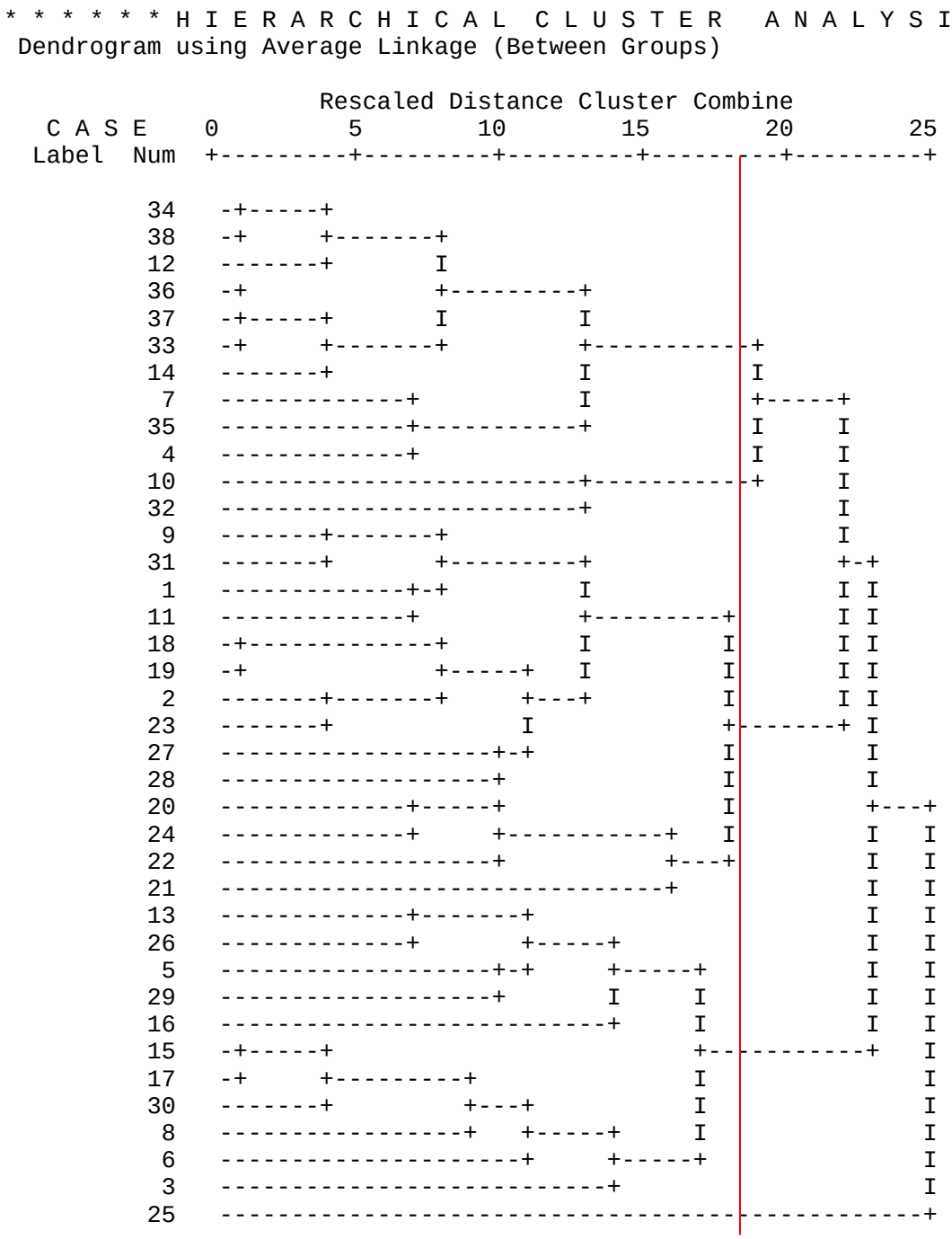
In the hierarchical cluster, the distance and metric units are flexible. The metric used to measure the similarity between pairs of variables/observations is asymmetrical and it progressively merges clusters as they get closer together (Romesburg 1984). The distance is constantly updated and changed. As the distance between observations increases, so does the distance between the clusters. At the end, each pair of variables has a greater distance than the previous one (Romesburg 1984). Hence, the researcher can stop clustering whenever the distance between variables is too big or too small. The decision is contingent on the researchers' discretion.

In determining when to stop clustering, "the number of classifications we want to have needs to be previously established" (Romesburg 1984:31). The dendogram (also called tree) serves to make the cut and determine the distance measure where the cut needs to be made. "Deciding where to cut the tree resolves the trade-off between the desire for detail (many classes/clusters) and the desire for generality and simplicity (few classes). The decision is subjective" (Romesburg 1984:31-32). The interaction to determine clusters was made considering average distance linkage between groups.

Upon completion of the hierarchical cluster analysis and based on the dendogram, four strong clusters were identified. These four categories were straightforward, broad, and appear natural. Thus, they responded to the desired number of classifications considering the three areas of study. The cut in the dendogram was then made at the distance of 18. The goal was to relate one or two classifications of bus stops per study area to make the representation simple and general. Thus, the selection process was made "to best achieve this planning objective" (Romesburg 1984: 68). A new field of classification was created based on the dendogram results and a cluster number was

assigned to each of the cases. *Figure 2 shows the dendogram with the clusters and rescaled distance.*

Figure 2: Cluster Dendogram



The hierarchical cluster serves to identify natural clusters and to assign a classification to the cases. The assigned classification is an early group and it represents an approximation of the initial groups or K-points / K-clusters (MacQueen 1967). Upon assigning a classification to each of the cases, the distance measure and centroids are recalculated using a K-means analysis.

> *"The Centroid is the average value of a group of objects in a cluster and is defined by the dimensions of the cluster. In a sense, it is the center of gravity for the respective cluster. The distance between two clusters is determined as the difference between centroids" (Sneath and Sokal 1973:359)*

K-means is one of the simplest unsupervised learning algorithms that solves clustering problems (MacQueen 1967). It simply classifies a given data set through a certain number of clusters (assume k-clusters) fixed a priori. In this case, clusters are fixed a priori using the hierarchical cluster dendogram (MacQueen 1967). In SPSS, "each datapoint/variable finds out which cluster center it is closest to. Thus, each cluster center owns a set of datapoint/variable" (Moore 2001). In addition, each center finds the centroid of the points it owns. The K-mean analysis is important to determine if the original approximations from the hierarchical cluster are accurate and if not it recalculates the cluster centers until the numbers of clusters is reduced to k (desire clusters). In other words, it serves to discover the correct number of clusters and eliminate cluster errors by calculating the average of each cluster and changing the cluster centers by their average (Kumar & KhrishanWasan 2010). The K-means method also produces a summary statistics for each group.

To find the optimal clusters and determine cluster membership, discriminant analysis is conducted.

> *"The main purpose of a discriminant function analysis is to predict group membership based on a linear combination of the variables and the procedure begins with a set of observations where both group membership and values are already known" (Stockburger 1997:3).*

In this case, the results from the hierarchical classification and k-means cluster center recalculation are used as the basis for the discriminant function. A second purpose for the discrimnant function is to reveal a general understanding of the dataset by giving an insight of the relationship between a group's membership and the variables associated with the clusters. The discrimnant function maintains the four desired clusters and helps to distinguish the differences between them. *Table 4 shows the cluster memberships with recalculated distances and Figure 3 shows the discrminant function with the optimal distribution of variables with each cluster and centroids.*

In summary, the cluster analysis can be described as follow:

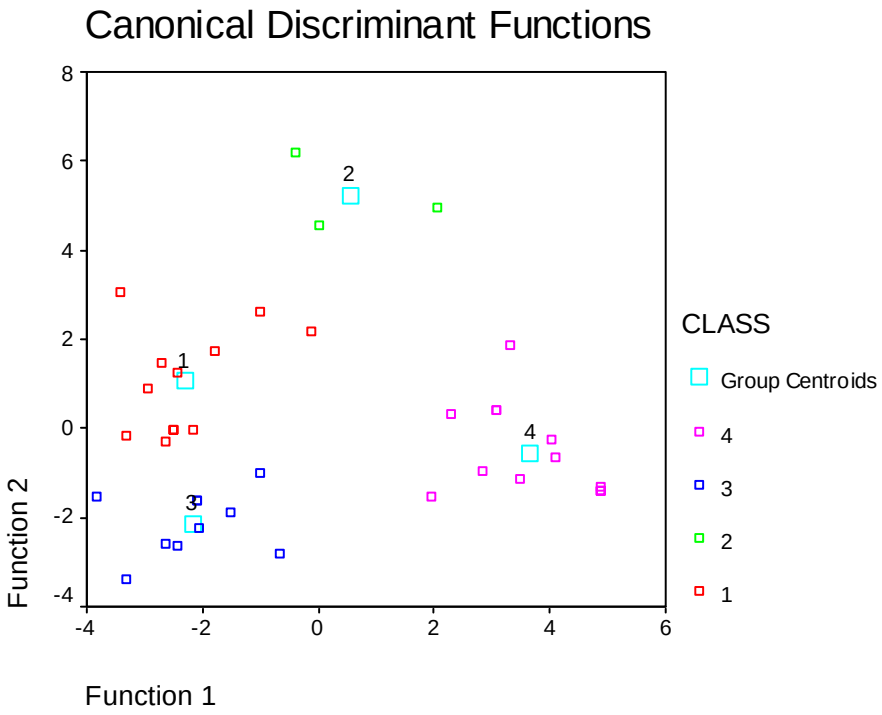
1) The hierarchical cluster dendogram is used to identify four clusters (desired clusters). This step is important to reveal natural groups and recognize initial classifications.
2) Match cluster classifications with cases (approximation of groups). This step is important to provide a priori classification for the K-means and give an approximation of clusters per case.
3) Then K-mean analysis is used to recalculate the position of the clusters (cluster centers) and verify the cluster classifications. This step is important to determine if the original clusters previously identified are accurate. If not accurate the cluster centers must be recalculated until they match the desired cluster numbers.
4) A canonical discriminate analysis is conducted to find the optimal clusters , distinguish cluster differences, and determine cluster memberships.

Ultimately, the multivariate cluster analysis adds to the findings of the correlation analysis by providing a common ground in the association of variables. The correlation reveals an association for the cluster shape and the cluster gives further meaning to this correlation / association by creating categories based on the distance between observations. Generally speaking, these categories will have an instrumental role in defining bus stops, the relevance of the correlation, and highlight the significance of the study as a whole.

Table 4: Cluster Membership

Case Number	Cluster	Distance
1	1	1.541
2	1	1.173
3	3	1.658
4	4	1.449
5	3	1.718
6	3	1.533
7	4	1.395
8	3	1.323
9	1	1.173
10	4	1.717
11	1	1.307
12	4	1.449
13	4	1.552
14	4	.933
15	3	1.072
16	3	1.533
17	3	1.072
18	1	1.021
19	1	1.021
20	2	1.155
21	1	1.791
22	1	1.646
23	1	1.369
24	2	.816
25	2	1.414
26	3	1.245
27	1	1.429
28	1	1.307
29	3	1.597
30	3	.975
31	1	1.021
32	4	2.081
33	4	.697
34	4	1.250
35	4	1.552
36	4	.697
37	4	.697
38	4	1.250

Figure 3: Discriminant Function Cluster Distribution and Group Centroids.



Variables Selection and Limitations

The data collected from the survey present two main limitations for the correlation and cluster analysis. First, the sample size is too small (38 cases) in comparison to the total number of variables in the bus stop survey (40 questions produced 198 variables). Second, not all the variables had significant responses. For example, for some variables the result was 0 because no data were reported for that field in the surveys. For other variables the result was a number below 10% and even as low as 0.1%, meaning that only one or two bus stops reported results in that field. These kinds of responses give little information to the study. Because of these two limitations, the numbers of variables to be analyzed in the cluster and correlation analyses were reduced.

For both the correlation and the cluster analysis (multivariate), only the variables that described physical elements and characteristics of bus stops (shelter, seating, sidewalk, landscape, lighting, landing area, and security measures) and negative environmental

attributes with five or more responses per field were selected. Upon the selection process, a total of sixteen variables were analyzed: eight for physical elements and eight for negative attributes.

CRIME ANALYSIS

Data Collection

One limitation of the Austin Police Department (APD) data is that they do not indicate whether the crime incident is at a transit setting or not. So there is no record or reported crimes on buses or at bus stops. However, APD does record the exact location of crime incidents. Thus, as a data collection instrument, 2007-2008 Austin crime incidents were compiled. Approximately, 65,535 crime cases were found in Austin and sorted by their proximity to bus stops using the ArcGIS spatial analysis tool. After sorting, a total of 36,503 crimes around bus stops were identified. The results revealed all types of crimes, including some family crimes and residential crimes. In the literature, bus stop crime is defined as "non-residential and non-family/dating crime," which includes crimes against a property or a person within the bus stop open environment (Loukaitous-Sideris 1993, 2001, 2005).

Based on this description of bus stop crime, APD data were then sorted in terms of non-residential and non-family/dating crimes. Therefore, all non-residential and non-family/dating crimes were selected. To accurately determine if non-residential and non-family/dating crimes can be considered bus stop crimes, a 400 foot buffer was calculated to define bus stop crime boundaries. The buffer was calculated using similar criteria from the bus stop survey that determines an average distance of 0.1 miles between two bus stops. In totality, 3,191 incidents were reported within the bus stop buffers. Because of the proximity to the bus stop and the type of incidents, the 3,191 cases were considered "bus stop" crimes. Bus stop crimes contribute to perceptions of safety.

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Method of Analysis

The analysis of the crime data provides evidence of the real context of crime around bus stops in Austin. In addition, it supports developing a general scenario of safety conditions and whether or not HT participants' perceptions can be corroborated with real crime data. Ultimately, it provides information on what frightens HT participants away from using the bus based on real safety threats or concerns. As mentioned above, ArcGIS 9.3 was used to identify, sort, classify, and analyze the crime data.

Crime identification and selection by proximity to bus stops

A GIS shapefile with 2007-2008 crime incidents and their exact geospatial location was provided by the Austin Police Department. This GIS shapefile was downloaded into ArcMap. Then, a general crime incidents layer was created from the shapefile's data set. This layer was merged with the bus stop locations and selected by its proximity to the bus stops. Using the spatial analysis tool, a buffer layer was created. This buffer layer included all the crime incidents reported within 400 feet from each of the bus stops.

Crime Data Classification

The goal of the crime analysis was to determine which types of crime incidents were reported around the surveyed bus stops. For this purpose, a new layer with the incidents located within the bus stop buffers was created. Using this layer, crimes were subsequently categorized into type I and type II. Loukatous-Sideris (2001) explains that Type I crimes are serious crimes and it includes crimes against a person (robbery, harassment, rape, assault). Type II crimes are mild-minor crimes and includes crimes against property and general offenses (pick pocketing, purse snatching, public nuisance, public intoxication, drug dealing, etc). Although relevant, these two categories are too general and limit the analysis of what kinds of crime are more frequent in bus stop settings. Therefore, to better define, identify, and locate crime incidents, the subcategories in table 5 were created using incident annotations. It is important to note that the subcategories have been separated extensively. This is due to the APD's theory that all mild-minor crimes have the potential to become serious crimes. This of course depends on the circumstances, proportion of the incident, and Texas Criminal Law.

Table 5: Crime Classification

TYPE I: SERIOUS CRIMES		TYPE II: MILD TO MINOR CRIMES			
Harassment, Physical Assault, or Murder	**Robbery or Theft**	**Crime against Property, Property Damage, or Criminal Mischief**	**Vehicle Burglary, Theft, or Abandonment**	**General Offenses or Misdemeanors Class A, B, or C**	**Other**
Aggravated Assault	Aggravated Robbery by Assault	Arson	Abandoned Vehicle	Accidental Injury	Deadly Conduct
Assault	Aggravated Robbery with Deadly Weapon	Burglary non-residential	Abandoned Vehicle (Store Facility)	Alcohol Consumption Violation	Documented Window Peeping
Assault by threat	Pocket Picking	Criminal Mischief	Auto Theft	Civil Disturbance	Emotional Disturbed Person
Assault Juvenile on Juvenile	Purse Snatching	Criminal Mischief by Arson	Burglary of Vehicle	Criminal Trespass	Interfere Public Duties
Assault on Peace Officer	Robbery by Assault	Damage of City Property	Junked Nuisance Vehicle	Criminal Trespass/Hotel	Resisting Arrest or Search
Assault with Injury	Robbery by Threat	Graffiti	Suspicious Vehicle	Criminal Trespass/Transient	Retaliation
Assault with motor vehicle	Shoplifting	Littering	Theft from Auto	Dang Drug Violation/Other	Sexual Performance by a Child
Assault by contact	Theft	Tentative Burglary non-residential	Theft of Auto Parts	Delivery Alcohol to a Minor	Suspicious Person
Child Abuse	Theft from Building	Violation of Park Curfew	Theft of Bicycle	Delivery Controlled Substances/Narcotics	Suspicious Vehicle
Documented Abuse or Threat	Theft from person		Theft of License Plate	Disturbance	Terrorist Treat
Felony Enhancement/ Assault with Injury	Theft of Public Servant		Theft of Vehicle/Other	Documented Abusive Language	
Harassment	Theft/appropriate stolen property			Documented Exposure	
Harassment of Public Servant				Documented Fighting	
Homicide				Documented Unreasonable Noise	
Injury to Child				Evading/Foot	
Injury to Disabled Individual				Found Controlled Substances/Narcotics	
Injury to Elderly				Indecent Exposure	
Intoxicated Assault				Manufacture Controlled Substance/Narcotics	
Murder				Noise Ordinance Violation	
Possession/Promotion of Child Pornography				Obtain Controlled Substance by Fraud	
Rape and Aggravated Rape				Obtain Dang Drug by Fraud	
Rape of a Child				Pedestrian on Roadway	
Serious Injury of a Child				Possession of Controlled Substances/Other	
Sexual Assault				Possession of Controlled Substances/Sin Narcotic	
Sexual Assault of Child				Possession of Dang Drug	
Stalking				Possession of Marijuana	
Statutory Rape of a Child				Possession of Prohibited Weapon	
				Possession of Alcohol/Age 16 and Under	
				Possession of Alcohol/Age 17 to 20	
				Possession of Firearm by Felon	
				Possession of Controlled Substances/Narcotics	
				Possession of Drug Paraphernalia	
				Prostitution	
				Public Intoxication	

To categorize crime in the GIS data set, a new field was added and a value was assigned to each of the subcategories. This method allow for crime incidents to be grouped in better defined categories. Upon completion of the grouping process, the layer was modified to present the crime incidents in terms of these subcategories. A specific symbol was assign to each subcategory and the symbols were shown in ArcMap. In other words, each symbol represents that subcategory, or group, of crime incidents.

Analysis and Quantification of Crime Data

Using the crime classification and subcategories, crime data were quantified. Most crime incidents fall within the general offenses subcategories followed by robbery, vehicle burglary, and physical assault subcategories. The difference in the number of incidents between general offenses, robbery, and physical assault is large. General offenses reported approximately one thousand two hundred and ninety-eight (1,298) incidents, robbery reported seven hundred and five (705) incidents, vehicle burglary reported four hundred and eighty-four (484) incidents, and physical assault reported three hundred and fifty-eight (358) incidents. Using the attribute table, a new field was created and a value, indicative of the type of crime, was assigned to each of the incidents within the general offenses subcategory. Specific symbols were assigned to each of the crime incidents in ArcMap.

At the end of the analysis, two GIS maps were created per study area. The first map shows all the crime subcategories within the bus stop buffer. The other maps show all the general offenses within the bus stop buffer. In general, the crime maps help visualize the concentration of crime and types of crimes around bus stops.

Chapter Three: Results and Observations

STUDY GROUP

A total of 69 faculty, staff and students participated in the study. Approximately 90% of the participants were students, and the remaining 10% were faculty and staff members. Out of 69 focus group participants, only a few admitted using the bus all the time or often (n=7), none of the participants used bikes (n=0).The majority of participants used cars as their main modal choice; either in their own vehicle or by carpooling (n=62). The 62 participants that used cars as their main mode of transportation reported using the bus sometimes to almost never. More females (n=45) than males (n=24) participated in the study. The composition of the focus group is described in table 6.

Table 6: Focus Group Composition

	Total participants	Males	Females
Focus Group 1	15	7	8
Focus Group 2	12	5	7
Focus group 3	22	4	18
Focus Group 4	20	8	12
Total	**69**	**24**	**45**

Out of the 69 participants of the study, only fifty-four (54) participants in groups 2, 3, and 4 completed the perceived safety short survey[3]. The *perceived safety* short survey links gender to perception of safety and experience with crime. Out of the fifty-four perceived safety survey responses, 20.37% (n=11) reported being physically attacked. Five of those physically attacked were females and six were males. These

[3] The short survey was not administered in Focus Group 1.

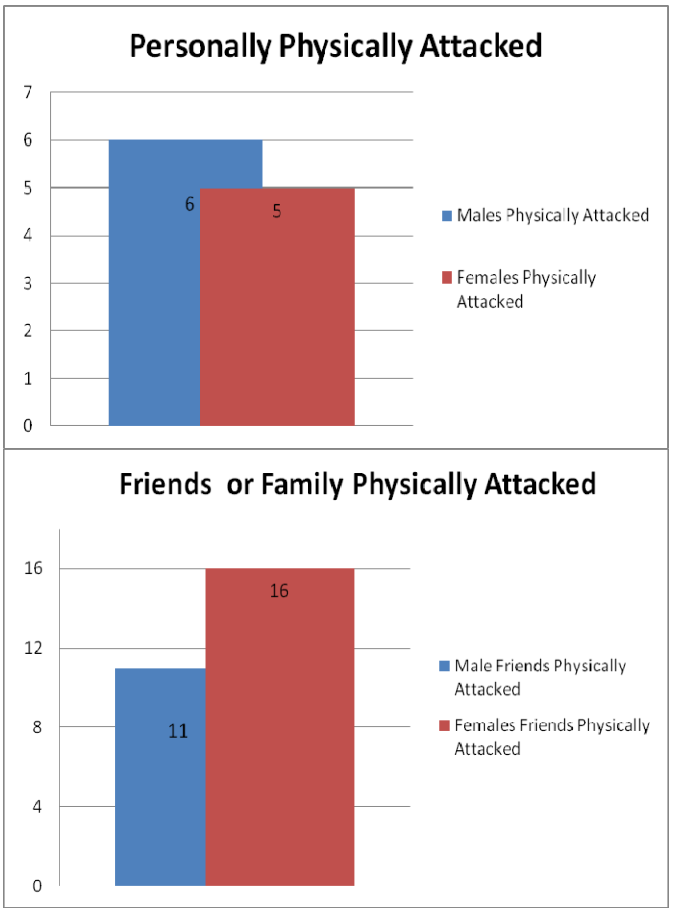
participants were clearer on the level of danger they fear. Participants related their fear to the presence of suspicious and violent people around their areas of activities. For example, a female student when asked what makes her feel unsafe in the built environment, replied *"Too many homeless people or drunks and drug addicts. They make me feel unsafe because I have something they don't (i.e. money, shoes, etc)"*. In general the participants mention that perceptions of insecurity prevent them from using public transit and waiting for the bus in areas perceived as dangerous produced a lot of fear.

Half of the group participants (n=27), reported knowing someone (a close friend or family member) who had been physical attack. Sixteen of those responses came from females and eleven from males. Out of the fifty-four responses recorded, 27% (n=15) reported not being physically attacked and not knowing of any physical assault victims. This statement clearly shows the relationship between the perception of safety and the actual experience with crime. It is in this evidence that perception becomes an abstract factor that limits the use of transit services (Loukaitou-Sideris 2008, British Department of Transport 2002). Table 7 and Figure 4 below presents some general results from the perceived safety short survey.

Table 7: Participants Distribution

	Total participants	Males	Females	Physically Attacked	Friend or Family Attacked
Focus Group 2	12	5	7	2	5
Focus Group 3	22	4	18	4	13
Focus Group 4	20	8	12	5	9
Total	54	17	37	11	27

Figure 4: Experience with Assault



In the *perceived safety short survey*, when asked to describe what makes them feel safe and unsafe the majority of the participants (90%) who had reported being physically attacked expressed their concerns about lighting (dim light, poor lighting, and dark areas) and suspicious people in the streets. "Suspicious people" is a term applied in this research to describe: drug addicts, homeless, drunkards, drug dealers, prostitutes, mentally-disturbed people, bums, violent people, and gangs. Regarding suspicious people, 12 (22%) participants mentioned the homeless as a safety concern. None of those 12 participants reported being victims of physical assault. One male and one female reported gangs make them feel unsafe. The female participant stated *"I feel insecure when there are a lot of gangs on the bus representing their colors."* These two participants also reported being physically attacked.

On the other hand, ten of the eleven (90%) participants who had been physically attacked stated that a police presence in the area makes them feel safe. Three females responded that they felt insecure in areas where males outnumber females. When asked directly what sort of things in the built environment cause them to feel insecure they responded:

> "*More men than women", "Lots of men because they're sometimes scary," and "I feel unsafe around a lot of males with no one around that I know. I feel this way because of all the things that I hear happen to women walking alone."*

One of the three females in this particular group reported being the victim of a physical assault and knows at least one person who was the victim of a physical assault. The other two reported not having any personal experience with physical assault incidents; however, one female did report knowing at least one person who was the victim of a physical assault.

Wilson and Kelling (1982) argued that in general people seem to be frightened of crimes involving sudden and violent attacks by strangers. However, this does not mean that their perception of safety is not influenced by other sources of fear such as the fear of being bothered by panhandlers, drunks, homeless people, gangs etc. "These people are not necessarily violent nor are they criminals, but they are unpredictable and intimidating to the average person" (Wilson & Kelling 1982:9).

When describing their perceptions, most participants reported being afraid of homeless persons, panhandlers, drunkards, gangs, and drug addicts. This is also amplified by their association of these suspicious persons with physical attacks. Two females, not part of the physically attacked group, reported being afraid of homeless people because they feel homeless people might attack them. When asked what sort of things make them feel unsafe one reported:

"[An] environment with homeless people, people hanging out in the street drinking/smoking makes me feel insecure because I feel that intoxicated people may attack me" and *"Homeless people make [me] the most insecure because they can steal from you, hurt you, or simply attack you (rape)."*

The post-it notes revealed that HT participants' perceptions of insecurity are often related to suspicious people (homeless people), and not to actual physical attacks. Two other females, not physically attacked, report being afraid of homeless persons because they might harass them. One of the females stated: *"There are a lot of homeless people walking around and they are quick to harass females"*. Another female went one step further by stating: *"Some homeless people [scare her] because they harass [people] for money if they think they have it*."

On the other hand, two female participants reported feeling unsafe in low income communities. They stated:

"Low class communities where danger is high and just the outlook of it"
"A lower economic neighborhood, not knowing people's intentions."

These two females reported not having any personal experience with assault, but knew at least one person who was the victim of a physical assault. One female reported being afraid of vandalized neighborhoods. Also, this female reported not having any experience direct or indirect with physical assault. She stated:

"Vandalized neighborhoods seem less secure because that is evidence that criminal activity has and does take place where you are."

Perception of Security and Insecurity

To understand safety perceptions it is important to look into the different sources of fear. For this study, one hundred and thirty-seven (137) comments on safety perceptions were collected from the perceived safety short surveys, transcripts, and post-it notes, which averaged 6.9 comments per participant. Comments were organized into topics (also called *thematic areas*) and in relation to safety perceptions. The topics with the highest percentage of comments were: well-maintained environment, good lighting, and police presence.

Thirty-one comments (31 or 23%) on perceptions of safety addressed the condition of the built-environment; supporting the idea that a well-maintained environment is perceived as safe. Thirty comments (30 or 22%) referred specifically to good lighting and twenty-nine (29 or 21%) to police presence as characteristics of a safe place. Regarding the percentage of participants commenting on specific topics, the study found that 57% of the participants made comments regarding a well-maintained environment (good condition of sidewalk, landing area, bus seating area, and landscaping among others). Also, 56% of the participants referred specifically to good lighting and 54% to police presence as environmental characteristics that sway their perceptions of safety. A well-maintained environment, good lighting, and police presence are the top three topic areas which most of the participants commented on when defining what makes them feel safe. Figure 5 presents these findings.

Figure 5: Perception of Security

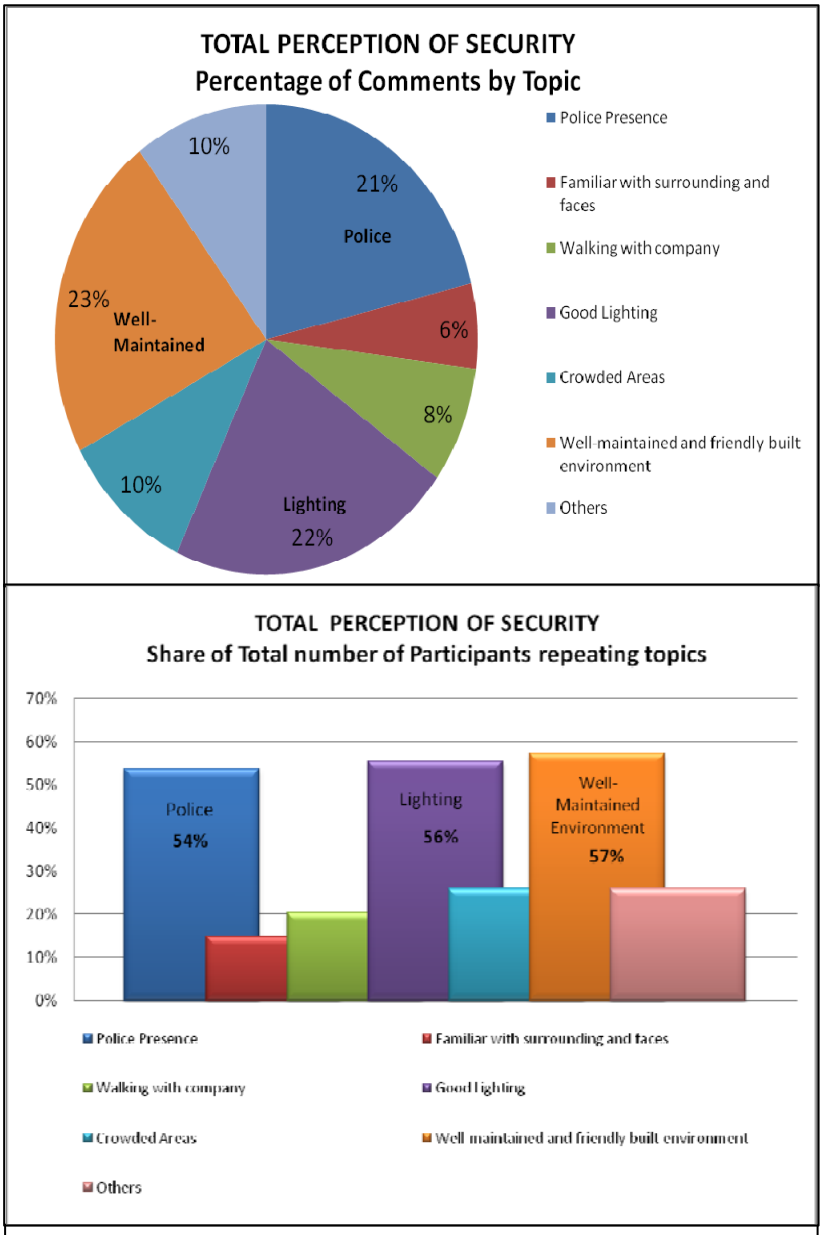


Figure 5 shows, 1) a pie chart with the percentage distribution of comments within the topics related to perceptions of security, and 2) a bar graph with the percentage of participants that addressed specific topics on defining perceptions of security. The pie graph distribution totals 100%, in reference to the total number of comments received (137 comments=100%) However, in the bar graph each column totals 100%, referencing the number of participants who made observations on specific topics.

One hundred and thirty-three (133) comments regarding the perception of insecurity were collected from the perceived safety short survey, transcripts, and post-it notes. An averaging of 6.0 comments per participant were made. Comments were organized in topics and in relation to insecurity perceptions. The topics with the highest percentage of comments were: isolated dark areas, suspicious people, and hot spots.

Out of a total of 133, thirty-six (36 or 27%) comments addressed a concern about isolated dark areas and considered bus stops with poor lighting unsafe. Thirty-three (33 or 25%) comments addressed suspicious people as a characteristic of unsafe bus stops. Particularly, the comments demonstrated a common fear of being disturbed or bothered by homeless people, and drug addicts. For example, a female, when asked in the short survey what make her feel unsafe stated: *"Too many homeless people or drunks and drug addicts. They make me feel unsafe because I have something they don't (i.e. money, shoes, etc)."* When asked about safety concerns, a group of students stated that while waiting for the bus or riding a bus: *"most could see people dealing drugs or soliciting prostitution."* Fifteen (15 or 11%) comments reported crime at hot spots as a safety concern. Hot spots are defined as high-crime bus stop locations, where danger is high, and vandalism occurs.

In addition, out of the sixty-nine (69) participants of the study, approximately 57% commented on isolated and dark areas, 61% on suspicious people, and 28% on hot spots as characteristics of unsafe bus stops. Isolated areas, suspicious people, and hot stops are the top three topics. Often hot spots are associated with low-income neighborhoods. For example, one female participant mentioned feeling insecure in "*Low-class communities where danger is high and just the outlook of it"*. A male reported not feeling safe in vandalized areas stating: *"Torn down areas, drug usage spots. A lot of bad people stay around these areas."* Figure 6 illustrates these findings.

Figure 6: Perception of Insecurity

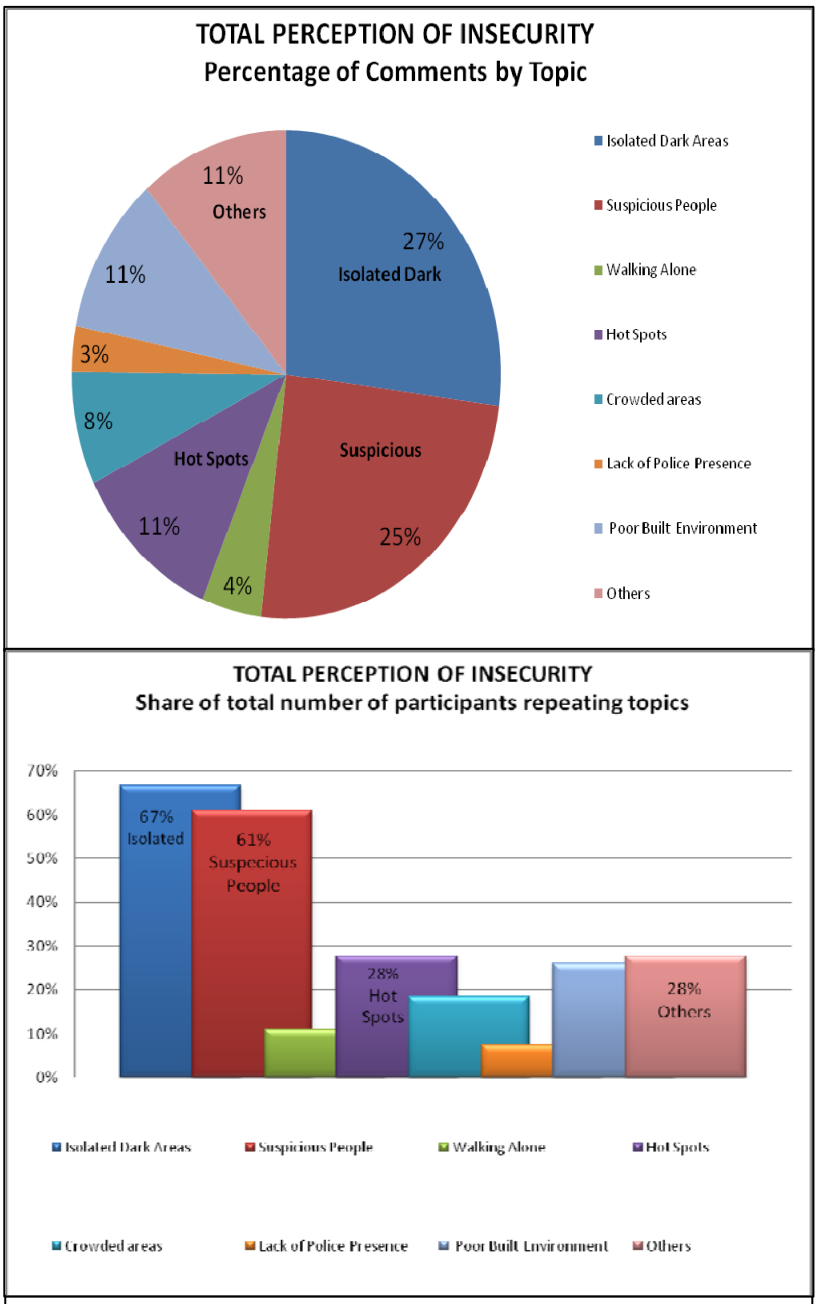


Figure 6 shows, 1) a pie chart with the percentage distribution of comments within the topics related to perceptions of insecurity, and 2) a bar graph with the percentage of participants that addressed specific topics on defining perceptions of insecurity. The pie graph distribution totals 100%, in reference to the total number of comments received (133 comments=100%) However, in the bar graph each column totals 100%, referencing the number of participants who made observations on specific topics.

Also, participants were able to identify some areas and bus stops considered unsafe. These bus stops are: 6th Street and Congress, 6th Street and Brazos, and 12th Street and Chicon. Downtown bus stops in general were associated with homeless persons, violent persons, drunken persons, and drug addicts. The focus group transcript notes defined downtown as a place where *"bums and drunk people are [a] barrier/deterrent"*. In the short survey, a female stated that she felt unsafe on 6th street. When asked what sort of things make her feel unsafe she replied: "*Sixth street at night because they shoot [guns-firearms]"*.

The 6th Street and Congress bus stop was mostly associated with people drinking and smoking marijuana. Transcript revealed: *"Bus stop at 6th and Congress [is] dangerous because of people drinking and smoking weed.*" Transcript notes also reported one person harassed by a drunken older man on 6th Street and Congress: *"One person was followed by a 'weirdo' at the 6th and Congress bus stop, also one person was hit-on [harassed] by drunken older man."* Several participants in the transcript notes identified 6th Street and Brazos bus stop as unsafe.

"[The] Bus stop at 6th and Congress/Brazos: horrible, smells bad, illegal activity; also covering and benches but people linger."

The 12th Street bus stops were noted as having poor lighting, isolated areas, drunken persons, mentally disturbed persons, and drug addicts. In the short survey, a female stated the following: *"I feel safe on HT's campus but as I walk towards 12th I get insecure."* This female also reported experiencing a personal physical assault. One female participant, also physically attacked, expressed her safety concern about 12th street, stating: *"I don't like 12th street, although our school is so close. I get my hair done there and I want to do a cleanup project, so our school won't be judged by its surroundings"*. Another female, not physically attacked, expressed her concern for HT area in general. She stated: "*[there is] violence in the neighborhoods around us. Every night I hear a bunch of police and ambulance sirens. Sometimes I hear gunshots."*

Overall, the results of the focus group data revealed what HT participants consider safe and unsafe in the built environment in the study areas. It traced the linkages between perceptions and personal experiences with physical assault related crimes. In addition, specific bus stops considered unsafe and why they are unsafe were identified. HT participants' bus stop descriptions provide a qualitative look at how some bus stops are designed and also describe their physical conditions and environments.

HT Focus group data revealed that walking to/from or waiting for the bus in an area perceived as unsafe is a factor that weighs heavily on their decision to use or not to use the bus services. The focus group and survey data also discovered that perceptions of safety are not the only factors influencing HT participants' decisions to ride or not to ride the bus. Waiting time, riding time, and bus routes are also relevant and influential in this decision. Despite admitting the high cost of owning a personal vehicle, the inconveniences of taking the bus and the perception of insecurity out-weighed that cost. In the transcript notes, when participants were asked what they would do if their car broke down, only four persons out of the sixty-nine chose the bus as an option, and it was not even the first option for many. Most of the participants would choose to call a friend, carpool, or even rent a car before riding the bus. Some stated that they would definitely *"Rent a car (if I had money) – carpool if not money"*. When asked why they would not ride the bus, besides perceptions of insecurity, participants mentioned:

> *"[the] Bus isn't convenient, takes too much time—only runs every hour, dirty buses, doesn't pass often enough, quicker to walk than catch the bus. I don't know how extensive the bus system is, no service in some areas, unreliable, inconvenient, inconsistent, and bus drivers are not helpful among others."*

On the other hand, HT participants did mention that safer bus stop environments would encourage more frequent use of the service. About 60% of the participants agreed that if the bus stops were perceived as safe, they would ride the bus. Among the benefits to changing their commuting patterns participants mention:

"less environmental pollution, less noise, less time spent in traffic jams, saving money on insurance, can do other things while traveling such as reading or catching up on sleep, no need to find parking lots, and help save on gas".

Perceptions: Word Frequency and Network Connections

Data provided by HT participants revealed details of which physical and urban attributes are associated with perceptions of security and insecurity while walking to/from or waiting for the bus. In weighing the relationship between perception of safety and physical characteristics of the build environment around bus stops, a simple word frequency analysis of all the comments made by participants during the focus groups and surveys, uncovered three main characteristics: poor lighting (repeated 75 times), police presence (repeated 63 times) and suspicious people (repeated 61 times)[4]. The results determined the relevance HT participants gave to some words or concepts when describing their perceptions. *Appendix B ATLAS-TI report (output –results) shows these findings*

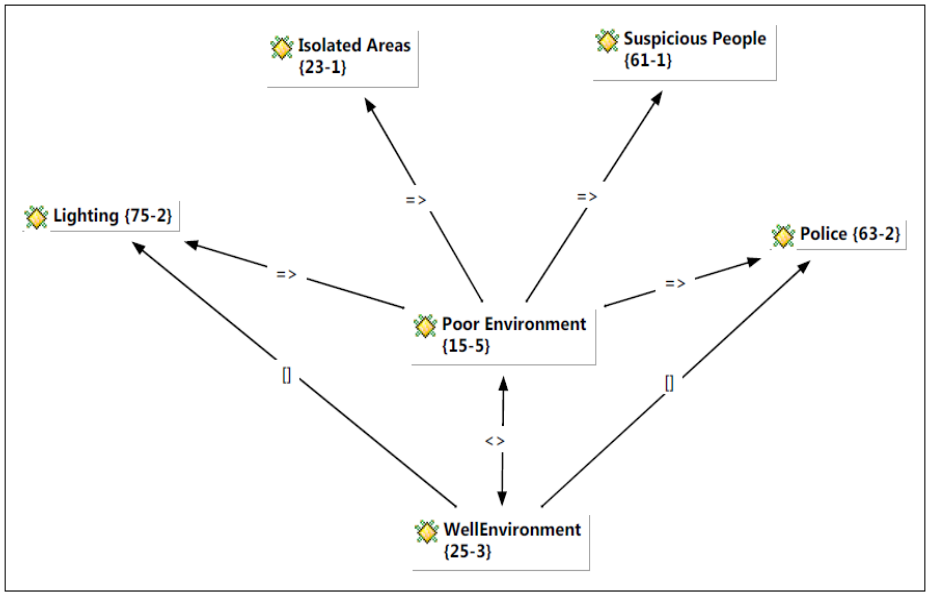
In conducting the word frequency analysis, word family groups were also created. These word family groups were automatically calculated by ATLAS-TI software and represent the number of concepts, or topics, to which each word is related. For example, the term "isolated areas" is only related to a poor built environment since it is often used by HT participants to describe a negative condition. The term "suspicious people" is also only related to a poor environment. In contrast, lighting and police presence are both terms used to describe both a good and a poor environment. Thus, lighting and police presence share two family groups. For example, the lack of police presence is related to a poor environment; while police presence is related to a good well-maintained environment. A well-maintained environment is related to three family groups: Police

[4] Using ATLAS-TI, about 262 words were coded in 2300 lines from Focus Groups transcripts, post-it notes, and survey.

presence, lighting, and poor environment. A poor environment is related to five family groups: lighting, isolated areas, suspicious people, police presence and well-maintained environment. The reasoning behind these relationship words can be used to describe both a poorly-maintained environment and a well-maintained environment.

The word family group connection is relevant to determine the context in which some words are used by HT participants when defining what is considered safe and unsafe in the built environment. To visualize these connections, a schematic layout was created between the selected words (or terms). The nodes describe the relationships which were based on logical association patterns with family groups. Figure 7 illustrate these results.

Figure 7: Semantic Layout for Word Network Connections



The schematic layout described the connection between words in terms of family groups. A well-maintained environment and a poorly-maintained environment are *"contrast/opposite* ***(< >)****"* to each other. Police presence, lighting, isolated areas and

suspicious people *"shared a relation (=>)"* with a poor-maintained environment". On the other hand, Atlas-TI considered that police and lighting *"are part of"* ***([])"*** a well-maintained built environment. These results contribute to the conceptual model presented in this report and corroborate with HT participants description of safety.

BUS STOP SURVEY

Frequency Analysis

There is a belief that certain characteristics in the built environment are related to peoples' fear, perceptions of the built environment, and even criminal actions (Louikaitou-Sideres 2001).Considering the paper's argument concerning safe and unsafe physical attributes, the bus stop evaluation was designed to collect data on multiple bus stops, micro and macro environments, through direct observation. The survey provides information on land use, conditions of the surrounding areas, and characteristics of the bus stops themselves.

Focusing on the three study areas, the survey identified different types of land use within a buffer of 400 feet around each bus stop. In this study, land use was defined by the type and condition of adjacent properties. A dichotomous variable (0-1) was used to measure the presence, or lack, of establishments belonging to a particular land use classification. The resulting data of the frequency analysis follows: Office Buildings (39.5%), Apartment Complex (23.7%), Bars and Pubs (21.1%) and Vacant Lots (15.8%). These are the most recurrent property classifications found around the thirty-eight (38) bus stops. In contrast, there were no daycares, hospital clinics, industrial sites, libraries or nursing homes found within the bus stop areas. Analyzing the results by bus stop locations: office buildings appear to be primarily in Downtown, bars and pubs are also primarily in Downtown, apartment complexes are primarily in the Riverside area, and vacant lots are primarily in the HT and Riverside areas.

HT focus group participants often revealed, *"bus stops in poor condition make them feel unsafe."* Focus group transcripts identified bus stops on 6th street and Brazos and 6th Street and Congress as being in poor condition. However, their argument is challenged by the results of the bus stop survey. In general, the frequency analysis results found that the majority of bus stops were in good to fair condition, including downtown bus stops. Most of them (71.0%) do have a seating area or free-standing bench for bus riders. Overall, seating was considered to be in good-fair condition (70%), and do not represent a hazard for bus riders. On the other hand, most of the bus stops (71.0%) did not have shelters. This can be due to limited public space dedicated to bus stop infrastructure or to private ownership conflicts. Nevertheless, of the bus stops that do have shelter, all were in good condition and almost all of them were accessible to persons in a wheelchair (91%).

The results of the frequency analysis also found that the physical characteristics of bus stops are different in the three study areas. Riverside has the highest percentage (92%) of bus stops with a seating area and it has one of the lowest percentages of seating areas with problems (25%). Riverside also has the highest percentage of bus stops with shelter (58%), and all the bus stops have sidewalks. Only two bus stops have sidewalk barriers that limit accessibility; however, only one bus stop was considered not accessible to persons in a wheelchair. Street lighting is present at 92% of the bus stops on Riverside with one exception. The bus Stop near the corner of E. Riverside and Kirkey has no lighting whatsoever. The block between East Riverside and Wickersham down to Riverside and Kirksey intersection, have "vacant lots" and "apartment complexes" as the main land use characteristics. The Riverside-Kirksey bus stop does not have shelter, a seating area, security measures, and the bus stop is not accessible to people in wheelchairs. Thus, this bus stop is considered to be in poor condition, but is still not hazardous to bus riders. Hazardous is defined as something dangerous, something that could hurt bur riders from normal use.

Most of the Downtown bus stops (72%) have seating areas in good-to-fair condition. As a matter of fact, only two bus stops have seating problems. On the other hand, only 9% of the bus stops reported have a shelter, and particularly one that is

accessible to persons in wheelchair. All downtown bus stops have sidewalks; however, 72% of the bus stops have sidewalk barriers, such as sign poles obstructing the pathway, and trees or bushes over the sidewalk. Also, street lighting is present at all downtown bus stops (100%) and some bus stops (36%) are also illuminated by adjacent properties' lighting systems. Regarding security measures, 81% of downtown bus stops have some kind of indirect security measure such as traffic cameras near bus stops, adjacent property surveillance cameras, and landing platforms.

HT area has the lowest percentage (53%) of bus stops with a seating area among the three areas and the highest percentage (63%) of seating problems. Only three (20%) bus stops have shelter and two (67%) reported having shelter problems. In addition, all bus stops in the HT area have sidewalks but 46% of the sidewalks have some kind of physical barrier obstructing the pathway. Street lights are present at every bus stop and 40% of the bus stops in the area have some kind of indirect safety measure such as landing platforms, recess walls, and traffic cameras.

The bus stop survey also addressed the bus stop's physical location and amenities. The results of the frequency analysis demonstrated that bus stops are often located within the travel lane (94.8%) and most of the bus stops have problems with the landing area (73.7%). Travel Lane locations can represent a safety hazard for those getting on or off the bus. Landing area problems are often related to wheelchair mobility as described by *ADA accessibility requirements for fixed-route bus services*. Out of the twenty-eight (28) bus stops with landing area problems, the majority (+50%) would be considered not accessible or minimally accessible to individuals in wheelchairs. The majority of the bus stops are nearside (60.5%), and have pedestrian amenities such as: visible crosswalks (73.7%), traffic lights (55.3%), pedestrian crossing signals (57.9%), and curb cuts at both corners (60.5%) for elders and persons with physical disabilities. Nearside are bus stops located right before street intersections.

Pedestrian amenities are not the same across the evaluated areas. For example, the HT area lacks continuous sidewalks; and thus, lacks crosswalks and curb cuts at all

corners. The Riverside Area lacks connectivity between crosswalks and the nearest intersections and the walking distance between bus stops increases from 0.1 miles (average distance between bus stops) to approximately 0.5 miles. Downtown is the only area that has reliable and consistent pedestrian amenities among all the bus stops assessed; however, it faces other traffic hazards for bus riders such as bus straddling crosswalks when stopping, bus stops right before crosswalks, and high speed traffic. *Complete Frequency analysis results of the survey in Appendix E.*

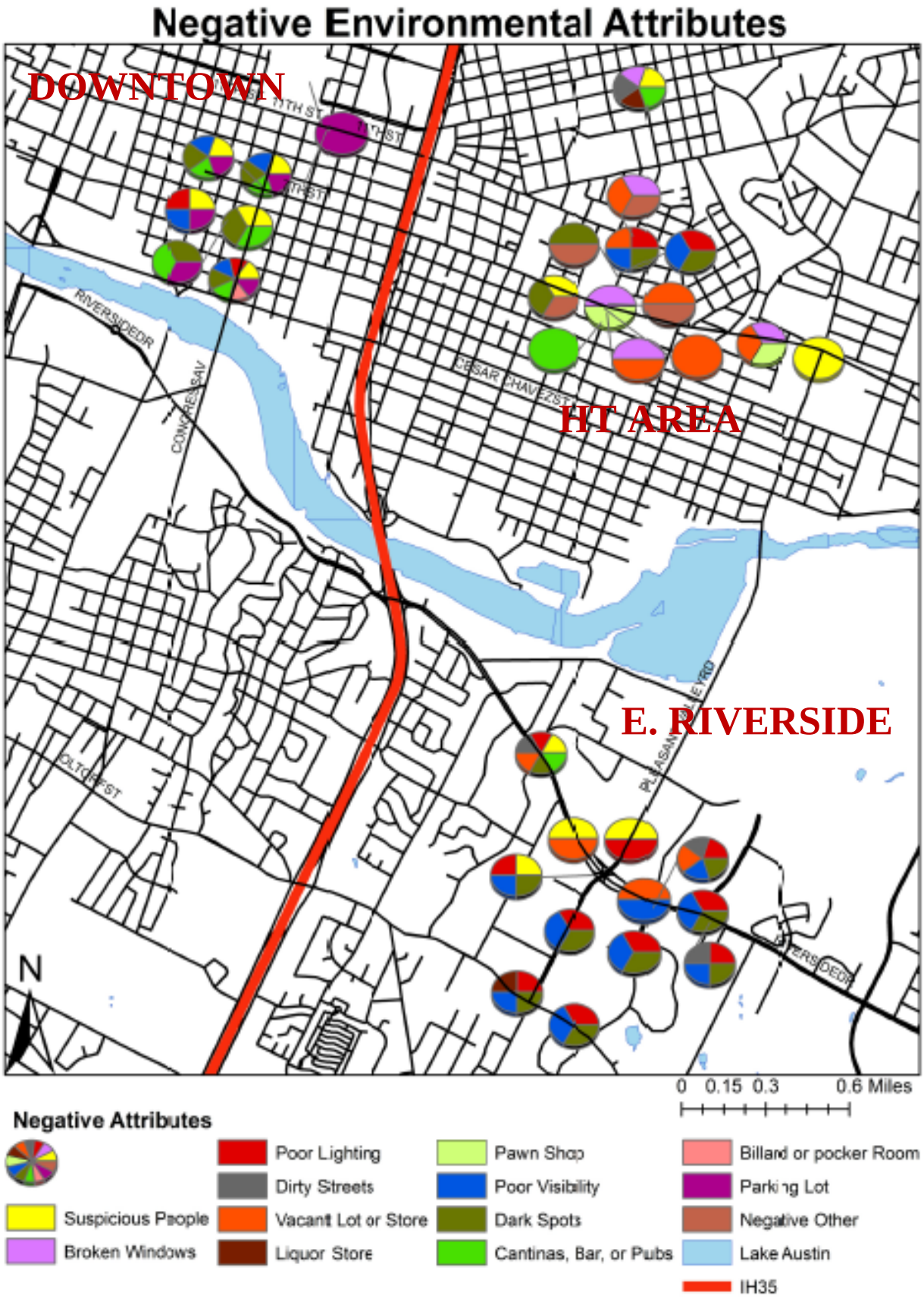
In regards to the physical attributes of the bus stops, a comprehensive description of the negative environmental attributes was collected from among the HT focus groups and survey data. The bus stop survey identified several negative attributes within a buffer zone of 400 feet around each bus stop. Dark spots (56.3%), poor lighting (46.9%), lack of visibility (43.8%), and the presence of suspicious people (37.5%) are the most frequent negative attributes found at bus stops. The presence of suspicious people around bus stops is also an issue brought forward repeatedly by HT participants during the focus group discussions. These factors influence their perception of safety and discourage them from using the bus. It must be noted, however, that no sex shops, motels, strip clubs, or XXX Video stores/theaters were found around the bus stops analyzed. These findings are consistent with Austin's cultural and development patterns, which often locate these kinds of facilities along I-35 Highway and away from urban populated centers. To better visualize and locate the negative attributes around the bus stops surveyed, a GIS map was created (Map 4).

Just as the physical characteristics of the bus stops are different in the three study areas, so are the negative attributes. The GIS Map 4 reveals a pattern among the three study areas. Out of eleven bus stops in downtown, seven have one or more negative attributes. Downtown bus stops are characterized by suspicious people, dark spots, cantinas/bars, parking lots, and poor visibility. Suspicious people are concentrated along Congress, and 2nd street to 5th street. Dark Spots, parking lots, and cantinas/bars are at almost every bus stop. Poor lighting was only identified at two bus stops near parking lots, and poor visibility at four bus stops, also near parking lots. Out of fifteen bus stops

in the HT Area, thirteen have one or more negative attributes. The area is characterized by vacant lots, dark spots, poor lighting mainly along Chicon Street, broken windows, and suspicious people. Suspicious people are mostly located near 7th Street and Pleasant Valley and 12th Street and Chicon bus stops. All twelve bus stops in the Riverside study area have one or more negative attributes such as suspicious people, poor lighting, dark spots, poor visibility, or vacant lots. In particular, suspicious people are mostly concentrated on E. Riverside towards I-35 and poor lighting and poor visibility are at almost all (84%) of bus stops in the area. Ultimately, vacant lots are located in E. Riverside Drive near Pleasant Valley, Wickersham, and Kirksey.

These results provide evidence of how bus stops look in terms of negative attributes, physical characteristics, and amenities. The results provide evidence of bus stop conditions and attributes that might affect HT participants' perceptions of safety. Also, it is possible to relate land use to physical conditions and attributes. By identifying patterns in the GIS Map, the results show the different characteristics of each area and the bus stops within those areas. Ultimately, the results allow the identification of various scenarios based on safety conditions.

In the GIS analysis of negative attributes, a pattern within the three areas was identified. Downtown bus stops show a predominant pattern of bars/cantinas/clubs, parking lots, suspicious people, and dark spots. HT bus stops appear to be more diverse, but with the largest concentration of vacant lots/stores. In contrast, East Riverside bus stops have a major problem related to poor lighting and poor visibility. Also, the map shows a pattern of bus stops with dark spots. Liquor stores and dirty streets seem to also be mostly present in the East Riverside area. The negative attributes map is congruent with the land use development pattern of the areas, as well as with the HT focus groups' description of negative attributes of bus stops.



Map 4: Negative Environmental Attributes

Correlation Analysis

Previous studies have indicated a connection between negative attributes and physical characteristics of bus stops (Ingalls & Owen 1994, Needle & Cobb 1997, Loukaitou-Sideris 2001 & 2008). To determine the strength and type of the relationship between negative attributes and physical conditions of bus stops in this study, a correlation analysis was performed using Pearson's coefficient test. Pearson's correlation measures the linear relationship and the degree of association between two variables. The closer the coefficient gets to +1 or -1, the stronger the correlation. The sign of the correlation indicates how variables are related. Positive values indicate that low values on one variable are related to low values in the other, and vice versa. Negative values indicate that low values on one variable are related to high values on the other and vice versa. The correlation gets weaker as the values get close to 0; thus, for this study < or = +/- 0.45 is considered the threshold (Xiong, Shekhar, Tan, & Kumar 2004; Johnston 2000).

The results of the correlation analysis help in defining how bus stops look. They also support the identification of different types of bus stop and their conditions. Ultimately, it assesses which negative attributes are mostly related to specific bus stop characteristics. Land use development patterns allow for the contextualizing of the results in the study areas. The results show a positive correlation (.562) between landing area and sidewalk. This means that when landing area values increase, sidewalk values will increase as well. According to the bus stop frequency analysis, 91.4% of the bus stops' landing areas are below the street level but also share space with the sidewalk. In other words, the sidewalk is often used as a landing area. Thus, it is rational to believe that more landing areas will mean more sidewalks.

Poor lighting and poor visibility also share a strong positive correlation (.723). When the lighting conditions deteriorate in the study areas, visibility will deteriorate as well. The *Negative Attributes Map* illustrates this relationship since most of the places with poor lighting also have poor visibility and vice versa. In the frequency analysis, 93% of the bus stops with poor visibility also have poor lighting. The Riverside area is a good

example of this phenomenon. Riverside shows the highest concentration of these elements of the three areas.

Another positive correlation was found between poor lighting and dark spots (.587). In other words, as poor lighting increases at bus stops, so do dark spots which bus riders will encounter. The frequency analysis supports the correlation analysis; 78% of the bus stops with dark spots also have poor lighting. Also, the *Negative Attributes Maps* show that most of the bus stops with dark spots also have poor lighting. The Riverside area shows the highest concentration of dark spots and poor lighting per bus stop. Alternatively, a negative weak correlation was found between poor lighting and security measures (-.430). If security measures increase, poor lighting will likely decrease. Improving security measures usually includes improving good lighting conditions. Based on the frequency analysis, most of the bus stops evaluated having one or more security measures (84%), do not show poor lighting as a negative attribute.

A positive correlation was found between suspicious people and cantinas/bars/pubs (.482). The more these kinds of establishments proliferate, the more suspicious people will wander around the area where these establishments are located. Downtown and East Riverside Drive provide a good example for this correlation. Downtown showed the highest percentage of suspicious people in the area. Also the land use analysis shows the highest concentration of cantinas/bar/pubs from the three study areas. The land use analysis of the East Riverside Corridor shows a high concentration of commercial offices, bars, and restaurants towards the I-35 exit. The negative attribute analysis reveals a concentration of suspicious people at bus stops located in this area as well.

Cantinas/bar/pubs also share a positive correlation with parking lots (.484). If the number of cantinas/bars/pubs increases in a specific area, so will the number of parking lots, parking garage, or open spaces assigned for parking. Downtown is a good example of these phenomenon. During the day, most of the parking spaces are used for office and commercial business. However, at night most of the parking spaces in downtown are related to specific bars/pubs. During the night some office buildings open their parking

garages to the public for a fee or associate with some nightclub for valet parking services. The land use analysis also indicates that parking lots are often associated with commercial zones, including pubs/bars/cantinas. The frequency analysis supports these findings as 75% of the cantinas/bars/pubs also have parking lots nearby to serve their businesses. *The correlation matrix in Table 8 shows these findings.*

The results of the correlation analysis give evidence to the strength of the relationship between variables when describing negative attributes and the physical elements of bus stops. As a result, the correlation analysis provides guidance on defining how bus stops look, how they are related to the study areas, and how they differ from each other within the study areas. Physical conditions are helpful when determining the relevance of some negative attributes and how they affect the condition of the area as a whole.

Table 8: Correlation Matrix

Correlations

		Shelter	Seating	Sidewalk	Lighting	Security Measures	Landing Area	Landscape	Traffic Hazards	Suspicious People	Broken Windows	Poor Lighting	Vacant Lot/Store	Poor Visibility	Dark Spots	Cantinas Bar/Pubs	Parking Lot
Shelter	Pearson Correlation	1	-.188	.105	.105	-.192	.187	.159	-.109	-.184	.095	.234	.409*	.078	-.024	-.187	-.117
	Sig. (2-tailed)		.258	.531	.531	.249	.261	.339	.513	.269	.571	.157	.011	.641	.884	.260	.483
Seating	Pearson Correlation	-.188	1	.226	.226	.030	.402*	.024	-.096	.410*	.019	-.014	-.183	-.024	.135	.133	.176
	Sig. (2-tailed)	.258		.173	.173	.858	.012	.889	.568	.011	.908	.935	.272	.889	.420	.426	.292
Sidewalk	Pearson Correlation	.105	.226	1	-.027	.140	.562**	.204	-.039	.112	.064	.126	-.275	.133	.156	.085	.071
	Sig. (2-tailed)	.531	.173		.872	.401	.000	.220	.817	.504	.703	.453	.095	.427	.350	.612	.671
Lighting	Pearson Correlation	.105	.226	-.027	1	.140	-.048	-.133	-.039	.112	.064	-.215	.098	-.204	-.173	.085	.071
	Sig. (2-tailed)	.531	.173	.872		.401	.774	.427	.817	.504	.703	.194	.557	.220	.298	.612	.671
Security Measures	Pearson Correlation	-.192	.030	.140	.140	1	.052	-.293	-.276	.338*	.141	-.430**	-.268	-.362*	-.275	.213	.215
	Sig. (2-tailed)	.249	.858	.401	.401		.756	.075	.093	.038	.398	.007	.104	.026	.094	.198	.194
Landing Area	Pearson Correlation	.187	.402*	.562**	-.048	.052	1	-.037	-.069	.199	-.175	.224	-.047	.236	.278	-.088	.127
	Sig. (2-tailed)	.261	.012	.000	.774	.756		.826	.681	.231	.294	.177	.781	.153	.091	.599	.448
Landscape	Pearson Correlation	.159	.024	.204	-.133	-.293	-.037	1	-.190	-.262	.155	.170	.116	.212	-.096	-.375*	-.241
	Sig. (2-tailed)	.339	.889	.220	.427	.075	.826		.252	.112	.353	.307	.489	.202	.564	.020	.145
Traffic Hazard	Pearson Correlation	-.109	-.096	-.039	-.039	-.276	-.069	-.190	1	-.093	-.257	.180	-.127	.190	.224	.122	.102
	Sig. (2-tailed)	.513	.568	.817	.817	.093	.681	.252		.577	.119	.279	.448	.252	.177	.467	.542
Suspicious People	Pearson Correlation	-.184	.410*	.112	.112	.338*	.199	-.262	-.093	1	-.097	.068	-.149	.030	.149	.482**	.327*
	Sig. (2-tailed)	.269	.011	.504	.504	.038	.231	.112	.577		.563	.685	.372	.856	.371	.002	.045
Broken Windows	Pearson Correlation	.095	.019	.064	.064	.141	-.175	.155	-.257	-.097	1	-.297	.298	-.314	-.369*	-.010	-.169
	Sig. (2-tailed)	.571	.908	.703	.703	.398	.294	.353	.119	.563		.070	.069	.055	.023	.952	.312
Poor Lighting	Pearson Correlation	.234	-.014	.126	-.215	-.430**	.224	.170	.180	.068	-.297	1	-.085	.723**	.587**	-.127	-.031
	Sig. (2-tailed)	.157	.935	.453	.194	.007	.177	.307	.279	.685	.070		.613	.000	.000	.448	.851
Vacant Lot/Store	Pearson Correlation	.409*	-.183	-.275	.098	-.268	-.047	.116	-.127	-.149	.298	-.085	1	-.116	-.208	-.162	-.259
	Sig. (2-tailed)	.011	.272	.095	.557	.104	.781	.489	.448	.372	.069	.613		.489	.210	.331	.117
Poor Visibility	Pearson Correlation	.078	-.024	.133	-.204	-.362*	.236	.212	.190	.030	-.314	.723**	-.116	1	.636**	-.021	.241
	Sig. (2-tailed)	.641	.889	.427	.220	.026	.153	.202	.252	.856	.055	.000	.489		.000	.901	.145
Dark Spots	Pearson Correlation	-.024	.135	.156	-.173	-.275	.278	-.096	.224	.149	-.369*	.587**	-.208	.636**	1	.286	.167
	Sig. (2-tailed)	.884	.420	.350	.298	.094	.091	.564	.177	.371	.023	.000	.210	.000		.082	.315
Cantinas/Bars/Pubs	Pearson Correlation	-.187	.133	.085	.085	.213	-.088	-.375*	.122	.482**	-.010	-.127	-.162	-.021	.286	1	.484**
	Sig. (2-tailed)	.260	.426	.612	.612	.198	.599	.020	.467	.002	.952	.448	.331	.901	.082		.002
Parking Lot	Pearson Correlation	-.117	.176	.071	.071	.215	.127	-.241	.102	.327*	-.169	-.031	-.259	.241	.167	.484**	1
	Sig. (2-tailed)	.483	.292	.671	.671	.194	.448	.145	.542	.045	.312	.851	.117	.145	.315	.002	

*. Correlation is significant at the 0.05 level (2-tailed).

**. Correlation is significant at the 0.01 level (2-tailed).

Cluster Analysis

It is possible to summarize the bus stop survey data by grouping bus stops into clusters solely based on physical and environmental attributes of stops. Can one then use those clusters to define bus stops in the study area? Can classification of bus stops be related to specific study areas? The answer is yes, and the cluster analysis is a useful descriptive tool that serves to clear this hypothesis and define the relationship between variables by developing categories of bus stops. In general, to reveal natural groups and classifications, it is an important exercise when defining how bus stops look and what attributes they share. In addition, these prototypes (clusters) of bus stops can be related to their relevant study areas, complement the correlation and frequency analyses, and provide additional evidence to thoroughly determine bus stop conditions.

To reveal natural and optimal groups, and similar patterns (composition) solely between the physical conditions and negative attributes of the bus stops, a multivariate cluster analysis was conducted, using *a hierarchical cluster classification, k-mean recalculation, and discriminant function cluster optimization*. The results revealed that the clusters are based on significant variables that have an effect on the bus stops conditions (dependent variable).

After narrowing the bus stop survey variables only to those ascribed to the physical elements and negative attributes of bus stops, four categories were clearly visible in the hierarchical dendogram. These four categories are straightforward and broad; thus, they respond to the number of classifications desired considering the three study areas. The cut in the dendogram was then made at a rescaled distance of 18. These four categories or classifications were then recalculated using the K-mean analysis. The k-means allows one to determine if the original approximations from the hierarchical clusters are accurate and to recalculate the clusters centers until the number of clusters is reduced to the desired four clusters. The four clusters classifications that resulted from the K-means were then analyzed using the discrmininant function to optimize the clustering process. The

discriminant analysis helps to distinguish the differences between the four desired clusters.

Based on the multivariate cluster analysis, these four categories share some common elements but also differ from one another. Cluster #1 is characterized as seating areas, sidewalks, poor lighting, security measures, landing areas, landscape, traffic hazards, and suspicious people. Cluster #2 is described as seating areas, sidewalks, poor lighting, and security measures, landing area, traffic hazards, suspicious people and poor visibility, dark spots, cantinas/bars/pubs, and parking lot. Cluster #3 is composed of sidewalk, poor lighting, security measures, landing area, landscape, and traffic hazard. Finally, cluster #4 is characterized by bus with shelters, seating areas, sidewalks, poor lighting, landing areas, landscape, traffic hazards, poor lighting, poor visibility, and dark spots. The attributes in the data matrix were scored on an ordinal scale of 0-3 for their ability to perform in each cluster type. However, seating area was the only attribute containing 2 and 3 scores; since seating area is an attribute present at most of the bus stops independently of its land use.

When the data matrix is cluster-analyzed, it is possible to relate clusters to the study areas if land use characteristics are considered. “The elements that are not clustered together in one branch are represented in the next one” and considering the land use, a pattern is revealed (Romesburg 1984: 48). For this cluster analysis, land use is used as a functional attribute to locate the clusters/classifications of bus stops and to narrow the cluster choices to the three study areas.

In accordance with the frequency analysis, only a few bus stops (28%) have shelter, and most of the bus stops with shelter are located in Riverside. Cluster#4 is the only one grouping bus stops that have shelters available to users. Cluster #4 composition also reveals other elements strongly related to Riverside. It has poor lighting, dark spots, poor visibility, and no security measure. The results of the bus stop survey reveal that all these variables are grouped together in Riverside; thus, making a natural cluster. On the other hand, cluster #4 classification in Riverside is also supported by the findings of the

correlation analysis. For example, the correlation analysis explains that poor visibility and poor lighting are strongly related and that most of the bus stops with poor visibility also have poor lighting. In contrast, poor lighting and security measures are negatively correlated. So often, bus stops that have high (severe) lighting problems might have low security measures. Cluster# 4 defines these correlations and makes them rational within the study area.

On the other hand, most of the bus stops (71%) have a seating area. However, most of the bus stops without seating area are located in HT area. Cluster #3 compositions is the only cluster with a low score (1) of seating area representation, meaning that most of the bus stops in that group do not have seating area. This phenomenon can be fairly related to HT area. Nonetheless, Cluster #3 shares similar and compatible elements with cluster #1. Seating area and the presence of suspicious people are the attributes that differentiate between the two. For example, both categories share sidewalks, poor lighting, security measures, landing areas, landscape, and traffic hazards. Based on these findings, cluster #1 and cluster #3 can be equally related to HT Area bus stops. HT area bus stops near Chicon and 12th Street and 7th and Pleasant Valley present different attributes than the rest of the bus stops in the area. Chicon and 12th street and 7th street and Pleasant Valley are commercial corridors and suspicious people are among the attributes. The commercial land use support seating at bus stops, due to the high pedestrian traffic. On the other hand, the rest of HT area is mainly single residential. Observation during our study reveals that in the HT residential area the number of bus users is low, pedestrian traffic is low, and bus stops often do not have a seating area. Hence, two types of bus stops can be identified in the area and the clusters help to reveal this finding and identify their characteristics.

Suspicious people, vacant lots, poor visibility, dark spots, cantina/bar/pubs, and parking lots are present at several bus stops, but they are also conditional to the land use of the area. The distribution of these variables in the four categories is what makes each cluster different and unique. For example, Cluster #2 includes dark spots, bar/cantinas/pubs, vacant lots, poor visibility, and parking lots. Base on the attributes of

cluster #2 classification, it can be related to the Downtown area. The correlation analysis supports this finding and shows a strong positive correlation between suspicious people and cantina/bar/pubs establishments. Also, Cluster #2 includes parking lots, which is another land use type of negative attribute associated to cantinas/bars/pubs. Downtown gives a good representation of this classification of bus stops and shows how these variables interact considering the land use of description (commercial, night entertainment).

The clusters also present some general attributes related to the bus stops in the three study areas. Sidewalk and landing areas are present at almost every bus stop, so they are part of the four clusters. Traffic hazards, poor lighting, and landscape are also present in the four clusters; however, these attributes can be subject to the physical circumstances at the bus stops and in the study area. For example, most of the traffic hazards are related to high speed traffic in a habitually pedestrian area (94.7%), bus stops right before crosswalks (94.7%), and bus stops with no near crosswalks (27.8%). Poor lighting is present at several bus stops (43.8%); however, it is a condition that affects the study area as a whole. People often relate poor lighting to the area, not to specific bus stop locations. People's perceptions of safety are ascribed to particular scenarios not single locations. Landscape (60.5%) is present at most of the bus stops. It is a double sided sword because it can be used to make the bus stop attractive; yet, trees and bushes can create shade during night time. Shade at night creates dark spots and present a danger to bus users.

In summary, it is possible to identify types of bus stops available to bus riders within the study areas based on negative attributes and physical characteristics. Considering the different elements and composition of the clusters, they can be distributed in the three study areas as the following: Downtown has Cluster #2 type bus stops, Riverside has bus stops similar to the ones presented in Cluster #4, and HT area has a mix of Cluster #1 and Cluster #3 types. *Table 9 shows the distribution of the clusters and their elements. Appendix F shows the complete cluster analysis with the hierarchical map.*

Table 9: Clusters Distribution

	Clusters			
Related Study Areas	**HT Area Commercial Zones**	**Downtown**	**HT Area Single Residential**	**Riverside**
	Cluster 1	**Cluster 2**	**Cluster 3**	**Cluster 4**
SHELTER	0	0	0	1
SEATING	1	1	0	1
SIDEWALK	1	1	1	1
POOR LIGHTING	1	1	1	1
SECURITY MEASURES	1	1	1	0
LANDING AREA	1	1	1	1
LANDSCAPE	1	0	1	1
TRAFFIC HAZARDS	1	1	1	1
SUSPICIOUS PEOPLE	1	1	0	0
BROKEN WINDOWS	0	0	0	0
POOR LIGHTING	0	1	0	0
VACANT LOT	0	0	0	0
POOR VISIBILITY	0	1	0	1
DARK SPOTS	0	1	0	1
CANTINAS / BAR/ PUBS	0	1	0	0
PARKING LOT	0	1	0	0

The results of the cluster analysis are valuable because they help develop significant groups of bus stops based on physical conditions and other attributes. It is a meaningful representation of how variables dynamically interact and collaborate in defining bus stop details (Romesburg 1984). It reveals the interdependence of some variables; for example, Cantinas/Bars/Pubs with parking lots, as well as suspicious people and poor lighting. It effectively determines which variables are often associated and shared under different categories. For example, the cluster also reveals a tendency for association between parking lots and cantinas, and landing areas and sidewalks. When

related to the frequency and correlation analyses, the clusters can be localized into the specific study areas. Overall, the analysis facilitates the creation of scenarios when determining what bus stops look like in each of the study areas, and how the sum of the elements affects these bus stops. For example, cluster 1 and 3 together describe the types of bus stops found in the HT area and what negative attributes are often present in relation to physical conditions. In this case, the HT area has two types of bus stops. The result is supported by the land use of the area which determines two types of development: commercial zone near 12th Street and 7th Street, and single residential in-between. Therefore, two scenarios can be identified while only having small differences, but these differences are relevant when making recommendations for improvements. The identification of these small differences was only possible through the cluster analysis.

Chapter Four: Crime at Bus Stop

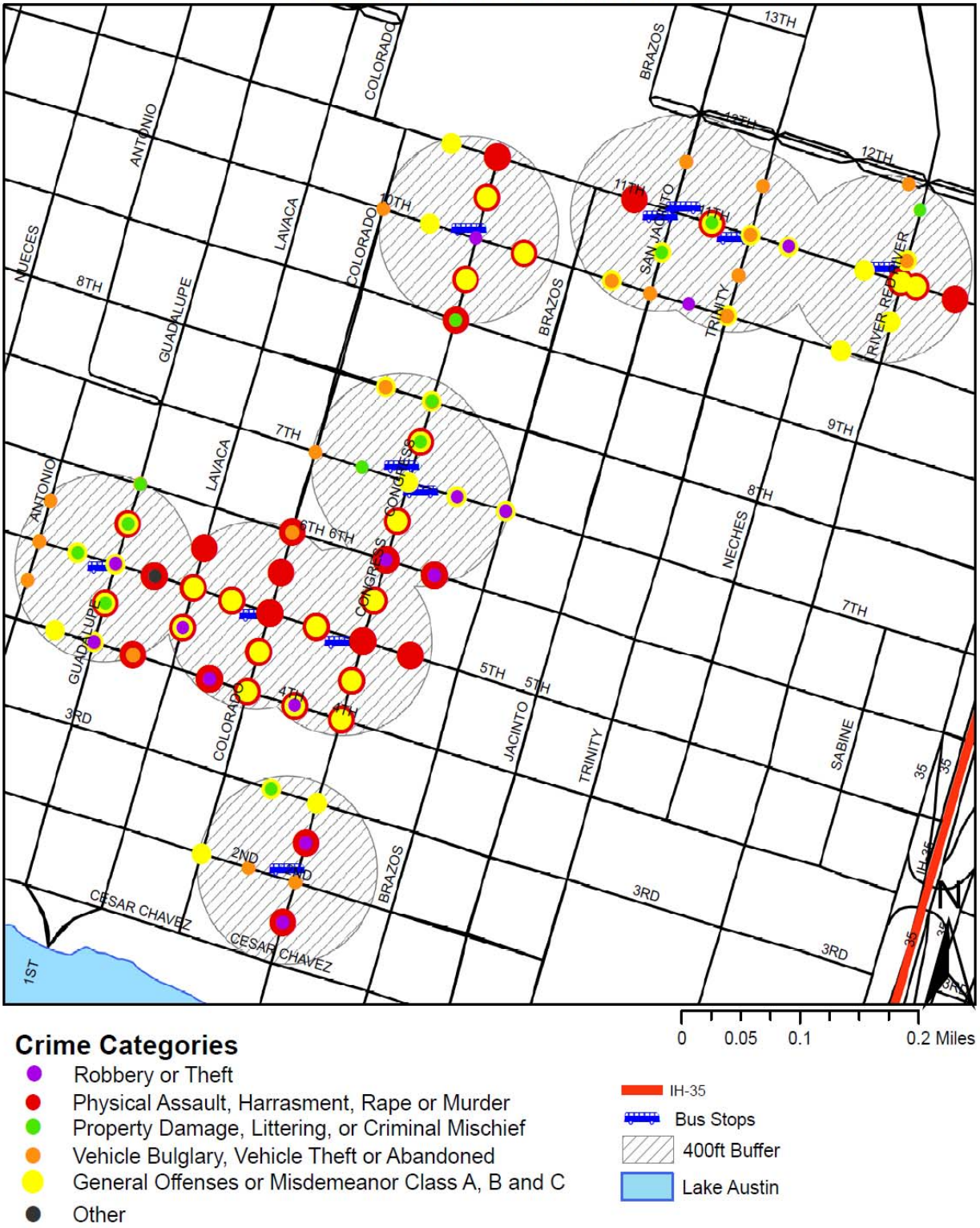
INCIDENTS AND CONTEXT OF CRIME

In analyzing the crime data, subcategory 1 (robbery or theft) and subcategory 5 (general offenses or misdemeanors class a, b, or c) have the highest overall number of incidents in the Austin surveyed bus stops. To determine a pattern of crime incidents by bus stop study areas, two GIS maps were created for each of the three study areas. The first set of maps indicates the six crimes subcategories in the three study areas and within the 400 foot bus stop buffer area. The second set of maps indicates the different types of general offenses and misdemeanor in the study areas within the 400 foot bus stop buffer area. *Maps and Summary of the three study areas are in Appendix G-H.*

The GIS physical analysis reveals that the downtown area has the highest spatial concentration of Type I crimes, or serious crimes, of all the three areas. Most of the crimes recorded are physical assaults, harassments, rape, theft, robbery by assault, aggravated robbery, purse snatching, and shoplifting. Although the data provided by Austin Police Department include incidents of murder and homicide, none of these crimes were reported in the downtown area. The data revealed that serious crimes are spatially clustered between 6th street to 4th Street and Guadalupe Street to Congress Street; all along Congress Street to be precise. This data is congruent with the HT Focus groups' observations on hotspots in the downtown area and corroborate with their perception of safety with real incidents and the context of crime.

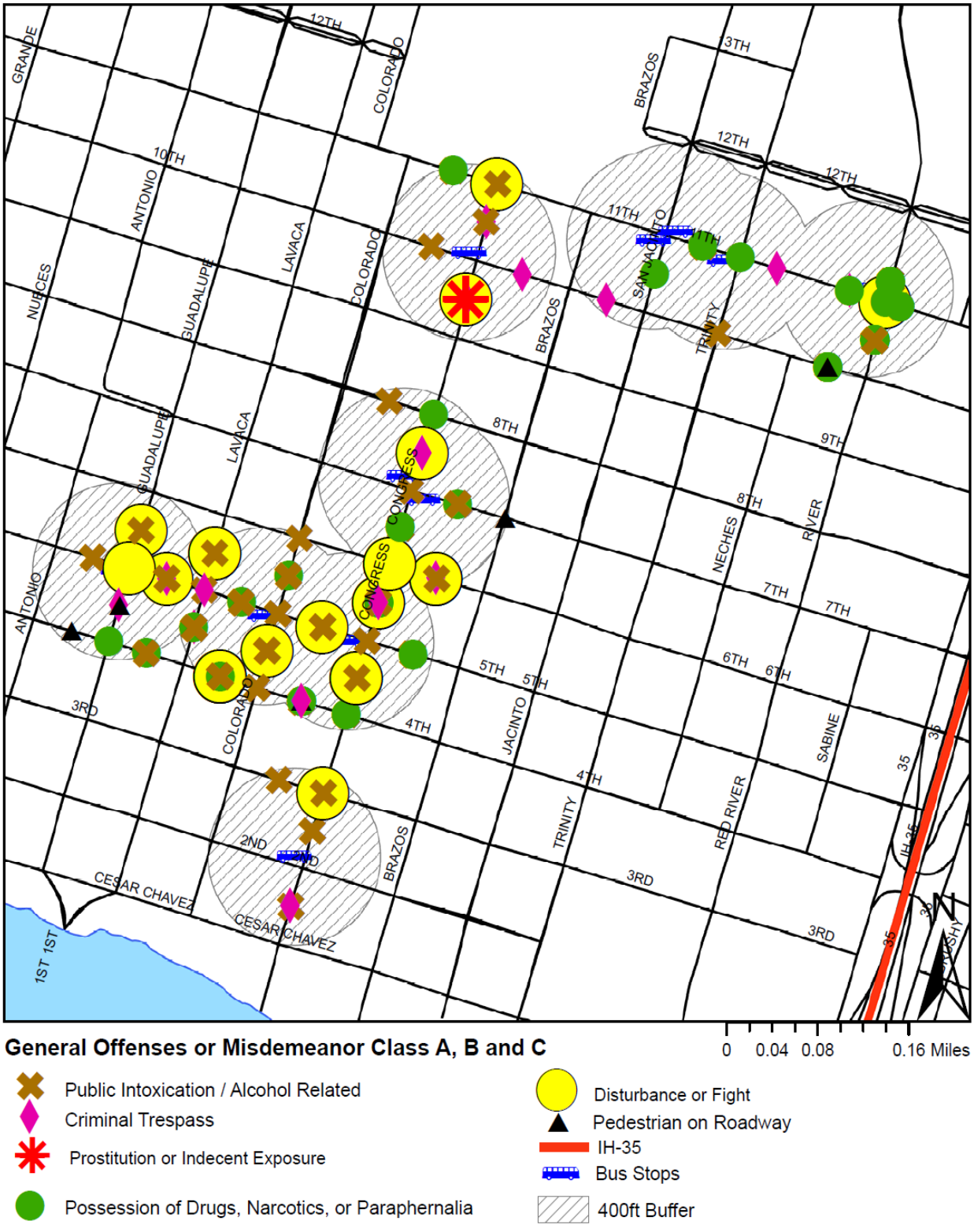
Downtown also shows a moderate concentration of vehicle burglary or auto theft around Trinity Street, 11th Street, San Antonio Street, and 2th Street bus stops. These four bus stops areas have a land use characterized by parking lots, parking garages, and parking open spaces. Thus, it is logical that most of the vehicle burglary or auto thefts are clustered around there. *Map 5 shows downtown bus stops crimes.*

The downtown area reported the highest concentration of general offenses and misdemeanors. The data showed a primary spatial cluster of disturbances and fights, public intoxication, and drug related offenses between 4th Street to 6th Street and Guadalupe Street to Congress Street. These same crimes seem to be present throughout Congress Street. In addition, Colorado Street and 6th Street bus stops reported the highest public intoxication incidents from all the surveyed bus stops. Congress Street reported one crime incident related to prostitution or promotion of prostitution near 11th Street. The 11th Street bus stops present a spatial concentration of drug related offenses; particularly from San Jacinto Street to the Red River Street intersections. The HT focus group data identified theses zones in downtown Austin as unsafe and even dangerous. Observations revealed that HT students avoid these bus stops and consider them unsafe due to the homeless, drug addicts, and suspicious people that wander around the area. Therefore, HT participants' perceptions of insecurity for those particular locations are corroborated by real context or incidents of crime. *Map 6 shows the distribution of general offenses.*



Map 5: Downtown Bus Stop Crime

General Offenses
Austin Downtown Area



Map 6: Downtown General Offenses

On the other hand, the HT Area showed a high-moderate concentration of serious crimes. The data revealed a spatial cluster of physical assault related crimes around bus stops on 12th Street-Chicon and 7th Street-Pleasant Valley. The rest of the serious crimes are mainly robbery, including theft, robbery by assault, aggravated robbery, and purse snatching. Theft crimes are spatially clustered throughout Chicon Street and 7th street. A few incidents of robbery were reported between 2nd and 3rd Street, but not enough to follow a pattern or be considered a cluster. The Austin Police Department did report a murder in the HT Area between the bus stops of 7th Street and Pleasant Valley. In addition, there are not many shoplifting crimes since the land use indicates it is a single family/residential area for the most part. *Map 7 shows HT Area Bus Stop Crimes.*

Regarding general offenses and misdemeanors (Class A, B, or C), HT area also showed a high spatial concentration of these types of crimes specially drug related offenses, particularly located along the 7th Street corridor and Chicon Street. The intersection between Chicon Street and 12th Street showed a particular cluster of drug possession offenses and public intoxication. Three prostitution incidents were reported on Chicon Street: one near 12th Street intersection and the remaining two, right across Huston Tillotson University campus (near the 11th Street intersection).In addition, data reveal a small cluster of drug possession and public intoxication offenses between the 2nd Street and Robert Martinez intersection. A small cluster of criminal trespass offenses were identified near 7th Street and the Pleasant Valley. *Map 8 shows HT Area distribution of general offenses*

HT area was closely analyzed by the HT focus group participants and some particular bus stops were avoided due to safety concerns. Specifically, the HT focus group participants' observations identified bus stops on 12th Street and Chicon and 7th Street Pleasant Valley as unsafe. Twelfth Street in particular is considered dangerous due to poor lighting and suspicious people (homeless and drug addicts) wandering around. Theft incidents are considered common in 7th Street and Pleasant Valley. In general, HT area crime results support the HT focus groups' perceptions of real incidents of crime.

Crime Incidents
Huston-Tillotson University Area

Crime Categories

- Robbery or Theft
- Physical Assault, Harrasment, Rape or Murder
- Property Damage, Littering, or Criminal Mischief
- Vehicle Bulglary, Vehicle Theft or Abandoned
- General Offenses or Misdemeanor Class A, B and C
- Other

0 0.1 0.2 0.4 Miles

IH-35
Bus Stops
400ft Buffer

Map 7: HT Area Bus Stop Crime

General Offenses
Huston-Tillotson University Area

General Offenses or Misdemeanor Class A, B and C

0 0.1 0.2 0.4 Miles

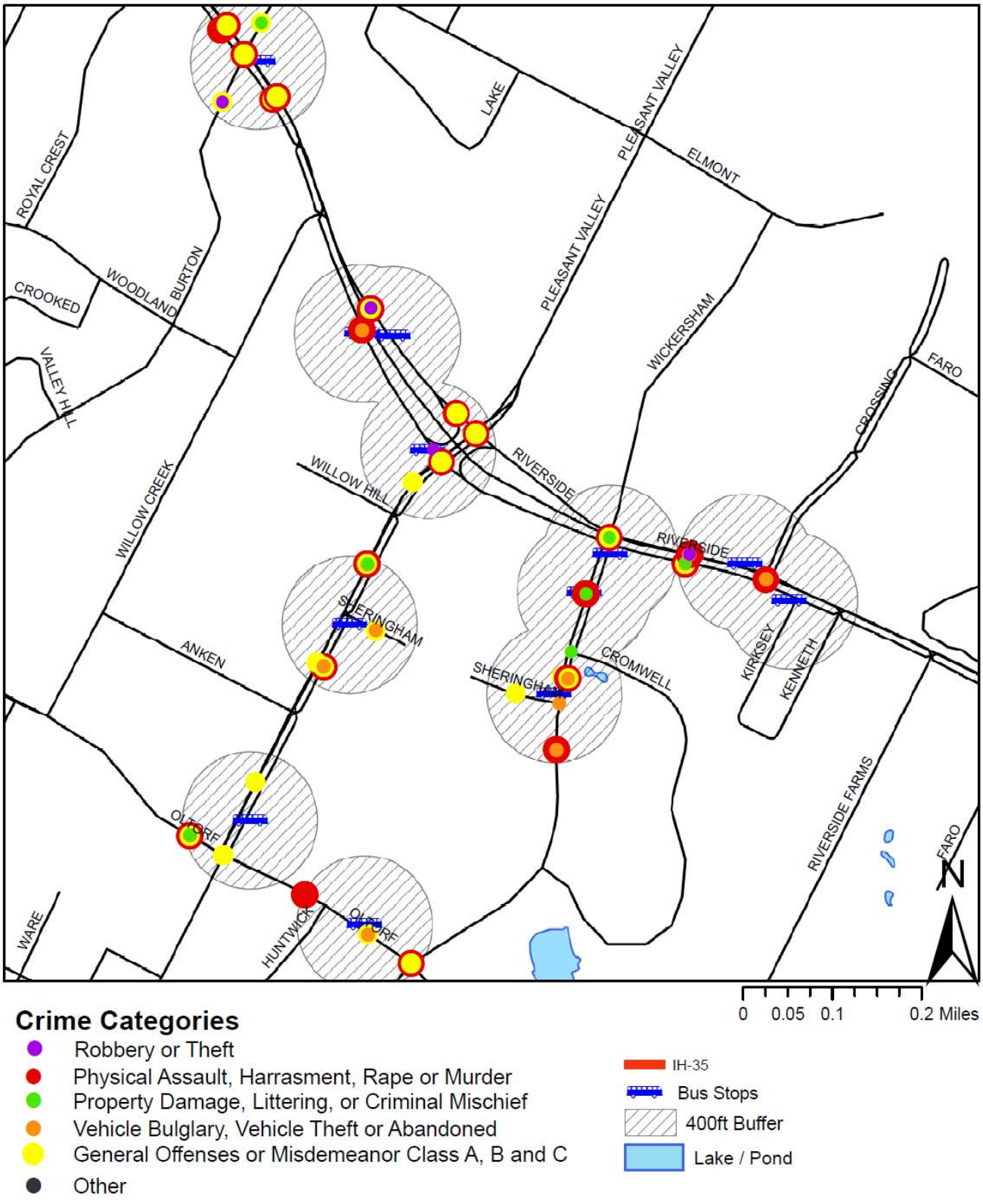
- Public Intoxication / Alcohol Related
- Criminal Trespass
- Prostitution or Indecent Exposure
- Possession of Drugs, Narcotics, or Paraphernalia
- Disturbance or Fight
- Pedestrian on Roadway
- IH-35
- Bus Stops
- 400ft Buffer

Map 8: HT Area General Offenses

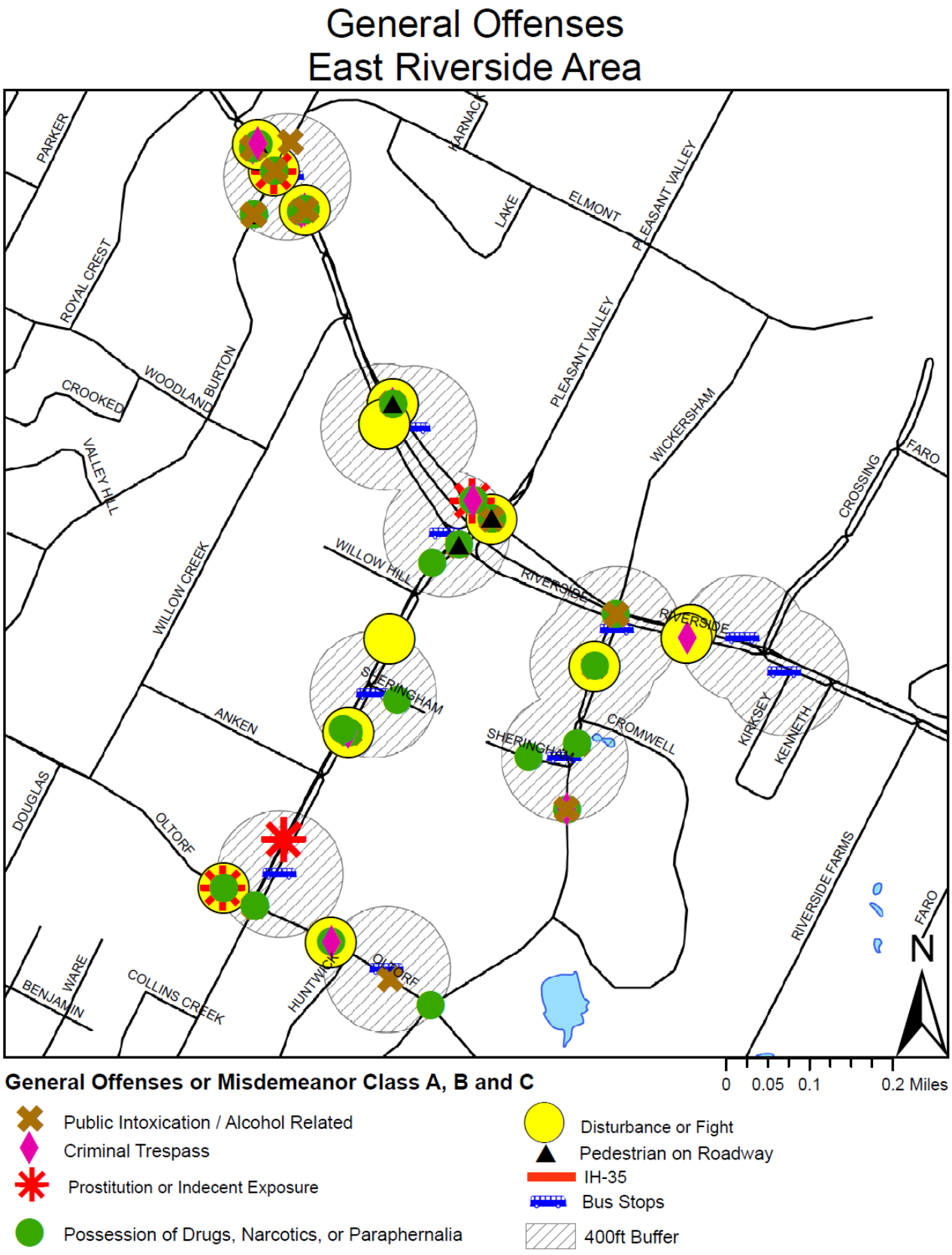
East Riverside presents a different crime scenario than HT and Downtown by showing a moderate-rather-low spatial concentration of crime around the surveyed bus stops. This might be due to the urban form characteristics (unfriendly for pedestrians), lack of bus stops, and the increased distance between bus stops. Physical assault related crimes are present at almost every bus stop location. The corner of Wickersham and East Riverside Drive does report having a murder. In general, most of the crime incidents are concentrated along the four major arterials that border the study area: Pleasant Valley Road, Oltorf Street, Wickersham Lane, and East Riverside Drive. *Map 9 shows Riverside Bus Stop Crime*

Property damage, littering and criminal mischief related crimes seem to be spatially clustered at the corner of Wickersham Lane and East Riverside Drive. This corner can be considered a hotspot for transit crime. This finding is consistent with the land use of the area which reported several vacant lots in that corner and along Wickersham Lane; thus setting the ideal conditions for crime to occur. On the other hand, the East Riverside Area also has a moderate-low spatial concentration of general offenses and misdemeanors. Civil disturbances offenses are present along the four major arterials (E. Riverside, Pleasant Valley, Wickersham, and Orltorf) following the pattern of serious crimes. Prostitution offenses are present in Pleasant Valley and are particularly prominent near the Oltorf intersection. *Map 10 shows Riverside distribution of General Offenses*

In contrast to the rest of the study areas, “pedestrian on roadway” offenses are recurrent in Riverside, particularly throughout the East Riverside corridor. East Riverside Drive also shows a concentration of public intoxication offenses. Drug related crimes are mostly present around Pleasant Valley bus stops with a few incidents near Wickersham bus stops. HT focus groups observations do not address Riverside as an unsafe area; but focus group participants did acknowledge the negatives attributes of the area such as poor lighting, poor visibility, and the lack of police presence. According to HT focus group participants, the agglomeration of negatives attributes at bus stops in general can make an area unsafe. The Austin crime data supports these perceptions



Map 9: Riverside Bus Stop Crime



Map 10: Riverside General Offenses

CONCLUSION

WHAT FRIGHTENS HT PARTICIPANTS FROM USING THE BUS?

Literature explains that negatives attributes at bus stops can affect the incidents of crime (Wilson & Kelling 1982, Loukaitou-Sideris 1999, and Liggett & Loukaitou-Sideris 2001). In addition to this, these negatives attributes can influence bus riders' perception of security, with or without a real context of crime. Following these arguments, the data in this study analyze environmental attributes, crime, and perceptions as isolated independent variables but conditional on each other. It finds the different kinds and agglomerations of negatives attributes at bus stops' micro and macro environments (considering the physical infrastructure of the bus stops). It also finds the different types of crimes that occurred within the surveyed bus stops' buffer areas. Also, it finds what HT students, faculty and staff consider safe and unsafe bus stops through direct observation, survey, and focus groups methodologies.

Viewed city-wide, Austin bus stops do not look more unsafe than other bus stops in other cities (Loukaitou-Sideris 1999). However, this is not really a comfort or response for citizens that are afraid of riding the bus or who have been victims of transit crimes. In fact, after putting together all the results and maps, it is possible to identify a pattern within the three study areas. Within these three areas, one can observe that crimes and negative attributes are not equally distributed and are concentrated in certain hotspots. These hotspots were the same areas previously identified by HT focus group participants as being unsafe. When analyzing all the data together, individual scenarios for the three study areas can be designed to address safety concerns and discover what frightens HT participants from using the bus. In other words, if HT focus group participants decided to use the bus stops right now, these scenarios will help determine what bus stops look like in terms of the physical characteristics, safety, and conditions of the surrounding area.

Scenario I: Downtown

The HT focus group data results provided evidence that there were safety concerns while waiting for the bus, and this influences their travel decisions and modal selection. Waiting time, accessibility issues, and lack of bus routes were also factors they considered. Regarding safety concerns, HT participants considered downtown, particularly 6th street and Congress and 6th and Brazos, as the most unsafe of the study areas. HT participants also reported that some of the bus stops in downtown were in poor condition or the infrastructure was poorly maintained. The bus stop survey analysis results show that in fact downtown bus stops have an abundance of negative attributes. However, none of the bus stops were actually in poor condition or poorly maintained based on the evidence of the bus stop survey. The infrastructure, including seating, sidewalk, landing area, landscape, and shelter, were actually in fair to good condition. Most of the surveyed bus stops (72%) in the downtown area have seating; although only one reported having a shelter.

Streetlights are also present at all downtown bus stops (100%) and 36% the bus stops also have illumination from adjacent property. In addition, Downtown has the highest percentage (81%) of security measures of the three study areas. In the correlation analysis a negative relation was found between security measures and poor lighting. This means that if security measures increase, poor lighting will decrease. The Downtown bus stops are a good example of this phenomenon. On the other hand, despite having fair lighting conditions, downtown also has a significant amount of dark spots near some bus stops. These dark spots are usually due to the landscaping, trees and bushes creating shades and limited visibility.

Wilson & Kelling (1982); Sherman, Gartin, & Buerger (1989); Loukaitou-Sideris (1999);and Liggett, Loukaitou-sideris, & Hiroyuki (2001) indentified suspicious people as a negative attribute that strongly alters and individual's perception of safety. Suspicious people are considered contributor to a powerful psychological deterrent that limits bus users, and even prevents them from using the bus at times. Wilson & Kelling

(1982) recorded examples of persons that admitted switching to the opposite side of the street in order to avoid an encounter, or to avoid walking close, to a person that looked suspicious, such as: homeless, drug addicted, and mentally-disturbed persons.

HT participants also mention that the presence of homeless persons, drunks, and drug addicts around downtown bus stops makes them feel unsafe. Congruent to what HT participants reported, downtown bus stops in general have a fair amount of homeless, drunks, and drug addicts wandering around. In the correlation analysis, a strong positive correlation was found between suspicious people and cantinas/bar/pubs establishments. The more these kinds of establishments proliferate, the more suspicious people will be found wandering around the areas where these establishments are located. Considering the land use of the area, downtown is characterized by pubs, bars, cantinas, nightclubs, and even a few homeless shelters. Thus, it is no revelation to observe these kinds of negative attributes in the area.

The cluster analysis provides detail on the types of bus stops located in downtown. These results match the HT participants' perceptions, as well as the detailed correlation and frequency analyses. Clusters #2 provides an important depiction of how bus stops look in downtown; they have suspicious people, landscaping, sidewalks, landing areas, cantinas/bars/pubs, parking lots, seating areas, poor visibility and dark spots. All of these elements were addressed by HT participants and also supported by the bus stop survey results.

When considering the negative attributes already identified, some bus stops might actually create conditions where crimes might occur. HT participants have serious safety concerns regarding downtown bus stops that limit them from using the bus services, especially at night. When looking at the crime data and incidents in downtown, the negative attributes and the presence of suspicious people, weigh even more on HT participants' perceptions of safety. The results of the crime analysis confirm that downtown has the highest concentration of incidents and most of these incidents are related to physical assaults, robbery, and general offenses/misdemeanors, such as

disturbance/fights, public intoxication, and possession of drugs. The crime observations, land use, and environmental attributes are complementary and the compositional outlook can explain HT focus group participants' perceptions of insecurity in downtown bus stops.

Scenario II: Huston Tillotson University Area

The HT participants considered HT bus stops unsafe because of the drug addicts, homeless persons, and the mentally disturbed persons wandering around the area. The lack of a police presence was also a factor that made some of the participants feel unsafe. Trees or bushes obstructing visibility and vacant lots were also considered a safety concern. HT participants mention specifically the fear for due to the lack of visibility and inability to see *"who is hidden in the bushes or vacant lots (which happen to be poorly maintained) that surround some of the bus stops in the area."* Within the area, HT participants identified 7th Street and 12th Streets as unsafe. However, they did not make any comments regarding bus stop infrastructure.

The bus stop survey results found that most of the bus stops in the area were in fair condition and they had fair seating areas. However, most of the bus stops lacked shelter. Also, most of them lack an accessible sidewalk and landing area, especially at bus stops located in Chicon Street. The results also show that most of the bus stops have one or more negative environmental attributes. The bus stop survey was able to indentify suspicious people, vacant lots, poor lighting, dark spots, and broken windows at the majority of the bus stops surveyed. These findings fit the HT focus group observations of the area.

Wilcox, Quisenberry, & Cabrera (2004); Taylor, Loukaitou-Sideris, Liggett, & Fink, et.al (2005); and Loukaitou-Sideris & Fink (2008), considered lighting, and poor visibility, as a safety concern and as an important element conducive to crime incidents For HT participants poor lighting and poor visibility in the HT Area, along with the presence of suspicious people, are real safety concerns as well. A positive strong

correlation was found between poor lighting and poor visibility. When lighting conditions deteriorate, visibility will deteriorate as well. The HT area illustrates this phenomenon. The negative attribute map of HT shows that most of the places with poor lighting also have poor visibility. Suspicious people and cantinas/bar/pubs correlation can also be applied to the HT Area; in particular the intersection between Chicon and 12th street and 7th street and Pleasant Valley.

The land use of the area develops the proper conditions for these types of negative attributes. Seventh Street and 12th Street are developing as commercial corridors. Twelfth street presents an agglomeration of bars, pubs, and cantinas. Thus, it is common to see suspicious people in the area. The rest of the area is characterized by single family residential and vacant lots, including bushes and trees. However, this also represents a challenge to bus rider safety because the bushes and trees limit and obstruct visibility and create dark spots. In the HT area, bus stops near vacant lots and residential do not always have adequate lighting and this issue is a valid safety concern.

The cluster analysis also describes types of bus stops in the HT Area and tracks the tendencies of the area's land use. Clusters #1 and #3 give a representation of how bus stops look in this area. Cluster #1 identifies the types of bus stops located near commercial zones. These types of bus stops often have a seating area, sidewalk, landing area, landscaping, suspicious people, and poor lighting. Cluster #3 identifies the types of bus stops located near single residential areas. These bus stops do not have seating areas and do not have suspicious people; however, they do have landscaping, sidewalks, and landing areas. Thus, their attributes are similar to Cluster #1 bus stops.

Crime data and crime incidents relate the perception of insecurity to a real crime context. The results of the crime analysis confirm that HT has a high concentration of serious crimes, mostly related to physical assaults and robbery. The intersection between 12th and Chicon has the highest cluster of incidents in the entire area. The intersection between 7th Street and Pleasant Valley (near HEB) present the second largest cluster where one isolated murder was also identified along with multiple incidents of robbery.

General offenses and misdemeanors were also present within the HT area. Possession of drugs, public disturbance, and public intoxication are the most common offenses. Again, bus stops at 12th street-Chicon intersection and 7th Street-Pleasant Valley developed the highest concentration of offenses. Drug related offenses are predominant on 12th Street. Overall, these findings match the results of the survey, land use, and focus group observations. The crime data supports HT participants' perceptions of insecurity in a real context of crime, and the results of the study corroborate with the land use and negative attributes of the area.

Scenario III: East Riverside

The HT focus group participants didn't give much detail about Riverside and they did not identify the area as unsafe. However, they do associate the area with poor lighting, poor visibility, dark spots, and a lack of police presence. For HT participants, police presence is vital to preserving a safety environment. No particular bus stops were identified in this area and no comments were made on the bus stop conditions.

The bus stop survey results reveal that East Riverside bus stops are actually in good condition. Most of them have seating areas, accessible sidewalks, and good landing areas. Some of these bus stops are in excellent condition since they are shared with the University of Texas Shuttle. In addition, most of the bus stops with shelters are located at East Riverside and Wickerhsam. The bus stop survey identified the distance between bus stops as being greater than in other bus stops in the study areas. Thus, walking distance is greater.

The results also show that Riverside has one or more negative attributes around the surveyed bus stops. Suspicious people are very common on East Riverside Corridor especially towards the I-35 exit. Poor lighting is an issue found at almost every bus stop in the area and it is linked to poor visibility and dark spots. A strong positive correlation was found between dark spots and poor lighting. Poor lighting conditions increases, so do the dark spots that bus riders encounter in the area. The frequency analysis shows that

78% of the bus stops with dark spots also have poor lighting. In the negative attributes map, most of the bus stops in iverside have poor lighting, dark spots, and poor visibility. These issues contribute to the HT participants' perceptions of insecurity overall.

Loukaitou-Sideris, & Iseki (2001), explain that urban forms (land use) influence bus stop characteristics and crime rates. East Riverside is a good example of this relationship. The land use of the area gives to criminal incidents which in turn give to the negative attributes in a criminal context. East Riverside Drive is considered a developing commercial corridor, especially to the west of Pleasant Valley where most of the stores, restaurants, bars, and grocery stores are located. Thus, it is possible to have suspicious people wandering around the area. The rest of the area is still developing and is characterized by vacant lots and apartment complex with open spaces and/or a rich landscape. Hence, bushes and trees are part of the picture, which supports more dark spots. As in the HT area, bushes and trees can obstruct visibility and develop dark spots, often perceived by bus riders as unsafe. These conditions can in fact present a danger to bus riders, especially at night.

The results of the cluster analysis were used to identify the types of bus stops along Riverside. These results relate to land use and negative attribute tendencies. Clusters #4 provides an important description of how bus stops look along Riverside. As the bus stop survey revealed, Riverside bus stops often have shelter, a seating area, landing area, and landscaping. However, the cluster reveals that these types of bus stops also lack sufficient security measures; in that they have poor lighting, poor visibility, and dark spots. These results are supported by the correlation analysis, HT participants' observations, land use assessment, and bus stop frequency results

Similar to the other two areas, crime data give a real context to HT participant's perception of insecurity. However, Riverside has a moderate to low spatial concentration of crime. This can be related to the relatively few bus stops in the area and the increasing distance between bus stops. As in the other study areas, serious crimes are present at almost every bus stop. In fact, the corner of Wickersham and East Riverside Drive

reported one murder and several incidents of property damage and criminal mischief. The bus stops near this corner are surrounded by vacant lots, and several negative attributes including poor lighting and poor visibility. Therefore, it offers specific conditions for crime to occur.

General offenses and misdemeanors are also common in Riverside. Disturbance and drug possession offenses appear to be at almost every bus stop. Public Intoxication is mostly common on west Pleasant Valley following the land use pattern of the area. These crime findings in general match the results of the bus stop survey on negative attributes and the land use description. Despite the above, HT focus group participants' observations on perception of safety do not predict danger in this area; however crime incidents and negative attributes indicate otherwise.

WHAT WE CAN DO ABOUT IT?

Several factors come into play when determining what frightens HT participants from using the bus. Negative attributes shape their perception of safety and these negative attributes have a real context of crime. The reviewed literature makes the argument that negative environmental attributes influence perceptions. This argument becomes feasible when analyzing HT participants' observations and the bus stop survey results of negative attributes (Loukaitou-Sideris 1999; British Department of Transport 2002).

Overall, the surveyed bus stops are for the most part in good –fair condition. However, the negative attributes, such as poor lighting, and suspicious people, weigh more than the aesthetic of the bus stops and have a direct influence on perceptions of safety. Perceptions after all, are important personal detractors from using the bus. In the case of HT participants, perceptions are so essential as to completely deter them from using the bus service and avoid certain bus stops. This particular finding matches the conclusions developed by Austin & Buzawa (1984), Ingalls & Owens (1994), Needle & Cobb (1997), and Loukaitoi-Sideris (2005), that "fear and anxiety about personal

security are important detractors from using public buses", causing people to avoid specific transit routes, buses, or to not use public transit at all (Loukaitou-Sideris 2005:2).

The empirical data presented in this study reveals that HT participants' perceptions are supported by a real crime context that corroborates many of their assumptions and beliefs. Also, the data provides empirical evidence that if HT students were to use the buses around their areas of activities they would be classified as unsafe based on HT perceptions of safety, negative attributes, and crime. Ultimately, perceptions are a big factor of why they prefer their private vehicles over public transit.

It can be concluded that the presence of certain attributes in the bus stops' micro and macro environments affect perceptions and are associated with crime incidents. This explains why the bus stops considered unsafe had at the same time negative environmental attributes and high concentrations of crime. Also, the analysis partially explains that perhaps the higher crime incidents at some bus stops are the result of the compositional characteristics of the built environment (land use, urban form, infrastructure, and attributes). The literature explains that indeed there is a strong correlation between the design and layout of the physical environment and the creation, or reduction, of opportunities for criminal activity (Loukaitous-Sideris 2001). However, in the case of HT participants, the perceptions are the ones that influence their decisions to ride private vehicles instead of public transit. It is not exactly how the area and bus stops looks in terms of design and layout, but rather how they feel at the bus stops; while riding the bus, waiting for the bus, or walking to the bus stop.

Transportation agencies and policy makers can certainly learn from the findings of this study. The results of these studies demonstrate that providing the bus service is not enough. It is also a matter of addressing the future bus riders' needs in terms of security and to tailor security strategies around those needs. It is possible to make the environment safer for future passengers. As presented in this study, crime data can be used to predict which bus stops tend to invite criminal activities, and which attributes of the environment are the most influential ones for crime. In addition, policy actions can be complemented

with design options. For example, providing adequate illumination at bus stops and trimming bushes and trees that might obstruct visibility improves the surrounding bus stop environment. Also, transportation planners should locate bus stops away from empty spaces and vacant lots. Based on direct observation, sometimes relocating the bus stops to a safer place can mean just moving the bus stop a few feet up or down the street (Loukaitous-Sideris 2001). If it is not possible to do so, at least create sufficient security measures at those specific bus stops to enhance a sense of security among bus riders.

The design of bus shelters can provide extra protection if, for example. a simple police call box is placed inside. The police call box has proven to be vital in preventing criminal activities. Keeping the landscaping of the bus stops clean, trimming bushes and removing tree branches can also assist in creating a safer environment. In addition, it sends the message that someone cares and is watching the bus stops. Regarding negative attributes, factors such as lighting, poor visibility, and litter are easy to deal with in terms of design. However, suspicious people are not exactly something that can be controlled, especially in the Austin downtown area; but perception of safety can be improved by providing additional security services at those bus stops. For example, foot or bicycle patrolling police, surveillance cameras, or warning signs can certainly reduce the fear bus riders have of suspicious people. Police patrolling and surveillance signs can send the message that someone is watching and in case of an emergency you can call for help. A police call box can also serve the purpose.

The cluster analysis also provides useful information for policy-makers to develop strategies suitable for bus stops in each of the three study areas. By defining clusters, policies can be made to assess resources of the city to specific locations and provide evidence of the regional needs. The clusters related to the land use, identify which kinds of activities tend to concentrate in specific bus stops locations; so policies for the improvements of bus stops can outline specific needs.

Finally, transportation agencies can develop fixed-route training courses for bus riders. Part of the problem with HT participants is that they were not aware of the

services provided by Capital Metro. With few exceptions, participants did not know bus routes and schedules. So, during the focus group it was hard for them to give more information about the services than the area where some bus stops are located. The fixed-route training course will solve these problems. Also, training courses will definitely create a sense of awareness and will help diffuse the transit options provided by Capital Metro. The training courses will educate bus users on safety concerns, security strategies, and accessibility alternatives. Training courses can help identify the needs of some population groups such as persons with disabilities, elders, and students. These courses can help develop security strategies at some bus stops locations with direct citizens input. Ultimately, it can help shape the perceptions of safety, perhaps making citizens feel more secure while riding the bus and waiting at bus stops.

As for future research, it would be beneficial to see if the conditions can change by increasing the sample size of both HT participants and participants at bus stops. Additionally, a survey can be conducted at bus stops or with bus riders while riding the bus. Perhaps while in direct contact with the bus and the bus stop environment, participants' perceptions will be different. Riverside presents a unique scenario where bus stops are shared with the University of Texas Shuttle. Thus, bus stops are in better condition. However, it would be interesting to determine if at these specific "shared" bus stops locations, perceptions between HT Shuttle users and regular bus users are different or similar.

The results of this study show that there is a fear of suspicious people, particularly the homeless. Perhaps it would be interesting to explore how homeless persons, in particular, perceive the bus stops and the bus services, what they fear, and how they perceive other bus stop users. Ultimately, a pilot bus stop can be used to implement all the design and attribute recommendations presented in this study. This pilot bus stop can be used as a control group, and a new analysis can be drawn on the perceptions and crimes to determine if in fact improving the attributes and conditions will perhaps improve perception of safety and the crime rate. The results of the pilot bus stop can be contrasted to the results of this study and new recommendations can be developed. Also,

a pilot group of participants can be used to determine if a training course will have an effect on perceptions of safety. It will be interesting to see if upon completion of training, users feel safer and more comfortable while using public buses. This pilot group of participants can be contrasted to the focus group participants of this current study.

Appendix A: Focus Group Comments and Record Data

Focus GROUP Analysis

	Total participants	Males	Females	Physically Attacked	Friend Attacked
	37		37	5	16
	17	17		6	11
Total	54			11	27

Built environment/Perception of Security									
Participants	Police Presence	Familiar with surrounding and faces	Walking with company	Good Lighting	Crowding Areas	Well-maintained and friendly built environment	Others	Total Comments	Average of Comments by Participant
Total	29	8	11	30	14	31	14	137	6.9
Percentage	21%	6%	8%	22%	10%	23%	10%	100%	
Pecentage of the Average	54%	15%	20%	56%	26%	57%	26%		

Built enviroment/Perception of Insecurity										
Participants	Isolated Dark Areas	Suspicious People	Walking Alone	Hot Spots	Crowding areas	Lack of Police Presence	Poor Built Environment	Others	Total Comments	Average of Comments by Participant
Total	36	33	6	15	10	4	14	15	133	6.0
Percentage	27%	25%	5%	11%	8%	3%	11%	11%	100%	
Pecentage of the Average	67%	61%	11%	28%	19%	7%	26%	28%		

Appendix B: ATLAS-TI Frequency Output and Results

CODES-PRIMARY-DOCUMENTS-TABLE
Report created by ANA - 02/06/2010 08:41:35 PM
HU: [C:\Users\Ana\Desktop\RESULTS.hpr6]

Code-Filter: All [6]
PD-Filter: All [71]
Quotation-Filter: All [262]

	Isolated Areas	Lighting	Police	Poor Environment	Suspicious People	WellEnvironment	TOTALS
P 1: 2-001.doc	0	3	0	0	1	0	4
P 2: 2-002.doc	0	2	0	0	1	1	4
P 3: 2-003.doc	0	3	0	0	1	1	5
P 4: 2-004.doc	1	2	0	0	2	0	5
P 5: 2-005.doc	1	1	1	2	1	1	7
P 6: 2-006.doc	0	3	2	0	2	0	7
P 7: 2-007.doc	0	1	1	0	0	1	3
P 8: 2-008.doc	0	2	0	2	4	0	8
P 9: 2-009.doc	0	1	0	0	1	1	3
P10: 2-010.doc	1	0	1	0	0	0	2
P11: 2-011.doc	0	2	0	0	2	1	5
P12: 2-012.doc	1	2	0	1	0	1	5
P13: 3-001.doc	2	2	0	0	0	0	4
P14: 3-002.doc	0	0	5	0	1	0	6
P15: 3-003.doc	0	1	2	0	0	0	3
P16: 3-004.doc	1	1	0	0	0	0	2
P17: 3-005.doc	0	2	3	0	1	0	6
P18: 3-006.doc	0	0	3	0	1	0	4
P19: 3-007.doc	0	0	2	0	2	1	5
P20: 3-008.doc	0	1	2	0	0	0	3
P21: 3-009.doc	0	2	2	0	0	0	4
P22: 3-010.doc	1	1	2	0	0	0	4
P23: 3-011.doc	0	2	2	0	1	0	5
P24: 3-012.doc	0	0	3	0	0	1	4
P25: 3-013.doc	1	0	0	0	0	0	1
P26: 3-014.doc	0	0	2	0	1	1	4
P27: 3-015.doc	0	1	1	0	1	0	3
P28: 3-016.doc	0	0	2	0	1	0	3
P29: 3-017.doc	0	0	1	0	1	0	2
P30: 3-018.doc	0	0	0	0	1	1	2
P31: 3-019.doc	0	0	1	0	2	2	5
P32: 3-020.doc	0	2	1	0	2	0	5
P33: 3-021.doc	0	3	2	0	1	0	6
P34: 3-022.doc	0	1	0	1	2	0	4
P35: 4-001.doc	0	0	0	0	0	0	0
P36: 4-002.doc	0	0	3	0	0	0	3
P37: 4-003.doc	0	0	1	0	0	0	1

P38: 4-004.doc	0	0	0	0	0	0	0
P39: 4-005.doc	1	3	2	0	0	0	6
P40: 4-006.doc	3	2	1	0	0	0	6
P41: 4-007.doc	0	1	1	0	0	0	2
P42: 4-008.doc	1	2	0	0	0	0	3
P43: 4-009.doc	0	0	1	0	0	0	1
P44: 4-010.doc	0	3	3	1	0	1	8
P45: 4-011.doc	1	1	1	0	0	0	3
P46: 4-012.doc	1	2	0	0	0	1	4
P47: 4-013.doc	2	2	0	1	0	1	6
P48: 4-014.doc	1	3	0	0	0	0	4
P49: 4-015.doc	0	2	0	0	0	0	2
P50: 4-016.doc	1	1	0	0	3	0	5
P51: 4-017.doc	0	0	2	0	0	0	2
P52: 4-018.doc	1	1	0	0	0	0	2
P53: 4-019.doc	0	1	0	0	0	0	1
P54: 4-020.doc	0	2	0	0	0	0	2
P55: NFG1NoteTa	0	1	1	0	2	0	4
P56: NFG1NoteTa	0	0	0	0	0	0	0
P57: NFG2NoteTa	1	1	0	0	1	1	4
P58: NFG2NoteTa	0	0	0	0	2	1	3
P59: NFG2NoteTa	0	3	0	3	5	0	11
P60: NFG3NoteTa	1	0	1	0	2	1	5
P61: NFG4NoteTa	0	1	2	0	3	2	8
P62: NFG4NoteTa	0	1	3	2	2	3	11
P63: PNFocus 1 Q	0	0	0	0	0	0	0
P64: PNFocus 1 Q	0	0	0	0	0	0	0
P65: PNFocus 1 Q	0	0	0	0	0	0	0
P66: PNFocus 2 Q	0	0	0	2	4	0	6
P67: PNFocus 2 Q	0	0	0	0	0	0	0
P68: PNFocus 3 Q	0	0	0	0	4	1	5
P69: PNFocus 3 Q	0	0	0	0	0	0	0
P70: PNFocus 4 Q	0	0	0	0	0	0	0
P71: PNFocus 4 Q	0	1	0	0	0	0	1
TOTALS:	23	75	63	15	61	25	262

Appendix C: Bus Stop Survey

BUS STOP SURVEY

Surveyor	Date/Time
Street Name/ Landmark/Intersection	Bus Route/Bus Stop Number

A. Bus stop Location and Transit experience

1) Is there a bus shelter?	Yes ☐	No* ☐
***If NO, please go to question 6**		
2) Is the shelter accessible by wheelchair? Can a person using a wheelchair fit in the shelter? (minimum space of a common mobility device is 30 inches by 48 inches 760mm X 1200mm)	Yes ☐	No ☐
3) Are there damages to the bus shelter? △	No problems ☐ Broken Panels ☐ Holes in the Roof ☐ Needs repainting ☐	Graffiti ☐ Missing Panel ☐ Uneven floor ☐ Other (Specify) _____
4) Rank the condition of the Shelter	1☐ 2 ☐ 3☐ 4☐ 5☐	
	1=Hazardous-broken glass, unstable 2= In poor shape though not hazardous 3= Fair, needs repainting, glass panels, needs cleaning, not hazardous bolts 4=Good, not perfect; but, no immediate repair needed 5=cosmetically excellent, new	
5) Which way does the shelter face? (orientation in relation to the street)	Facing Towards the Street ☐ Facing away from the street ☐	Facing on-coming traffic ☐ Other (specify) _____
6) What type of seating is available at the bus stop?	No seating* ☐ Bench inside the shelter ☐ Freestanding bench ☐	Fold down bench ☐ Leaning bench ☐ Other (specify):_____
***If NO seating, please go to question 9.**		

7) Are there problems with the seating? △	No problems ☐ Broken pieces ☐ Need painting ☐ Filthy /Rusty ☐ Bushes/roots obstructing seating ☐	Graffiti ☐ Not securely installed ☐ Cracks and Holes ☐ Other (Specify):_____
8) Rank the condition of the Seating	1☐ 2☐ 3☐ 4☐ 5☐	
	1= Hazardous, broken, someone could get hurt from normal use 2=In poor shape. though not hazardous 3=Fair, needs repaiting, needs cosmetic attention, not hazardous bolts 4=Good, not perfect; but, no immediate repair needed 5=Cosmetically excellent, new	
9) Where is the bus stop positioning in relation to the nearest intersection?	Nearside (before the bus crosses the intersection) ☐ Not near an intersection ☐ Mid-block ☐	Far side (Afte the bus crosses the interesection) ☐ Freeway bus pad ☐ N/A ☐
10) Adjacent property address (or name of business if visible)		
11) Adjacent property description△	Apartment Building ☐ Day Care ☐ Government Building ☐ Hospital ☐ Human Services Agency ☐ Industrial Site/Building ☐ Library ☐ Mall/Shopping Center ☐ Nursing Home ☐ Office Building ☐ Bar/Pub ☐	Park ☐ Park and Ride ☐ Place of Workship ☐ Residence-Townhouse ☐ Single residence ☐ Retail Store ☐ School ☐ Supermarket ☐ Transit Station/Hub ☐ Vacant Lot ☐ Other (Specify):_____
12) Distance from the previous bus stop in feet?		
13) Is there a visible companion bus stop across the street?	Yes ☐ No ☐	
14) Where is the landing area positioned in relation to the curb/street	No landing area * ☐ Below street level (low ground or shoulder) ☐ Sidewalk ☐ Shoulder ☐	Adjacent ☐ Bus Bulb ☐ Off-Road ☐ Other (Specify):_____
***If NO landing area, please go to question 17.**		

15) What's the material of the Landing Area?	Asphalt ☐ Concrete ☐ Gravel ☐ Other (Specify):_____		Dirt ☐ Grass ☐ Pavers ☐ N/A ☐		
16) Are there problems (accessibility related) with the landing area?		No Problem	Not Accessible	Minimally Accessible	Accesssible
	Bushes/Trees/Roots	☐	☐	☐	☐
	Wheelchair mobility (too narrow)	☐	☐	☐	☐
	Surface Uneven	☐	☐	☐	☐
	Slopes up from the street	☐	☐	☐	☐
	Slopes down from the street	☐	☐	☐	☐
	Requires stepping over drain inlet	☐	☐	☐	☐
	Other (Specify)_____	☐	☐	☐	☐
17) Is there a sidewalk?	Yes ☐		No* ☐		
***If NO sidewalk, please go to question 20**					
18) Are there any physical barriers that constrict the width of the sidewalk? (within the bock on which the bus stop is located)△	No physical barriers ☐ Electric/Telephone Poles ☐ Trash Cans ☐ Benches ☐ Newspaper Stand ☐ Sewer/Drainage Inlet ☐		Tree/Roots/Bushes ☐ Traffic Signs (Stop/Yield/etc) ☐ Police Call Box ☐ Public Phone ☐ Street Light ☐ Other (Specify):___		
19) Rank the condition of the sidewalk	1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐				
	1= Hazardous, large breaks, cracks, root uplifting, someone could get hurt from normal use or use of a wheelchair would be difficult 2=In poor shape though not hazardous, very rough, some root upflifting, cracks, breaks 3=Fair, minor root uplifting, minor cracks or breaks 4=Good, not perfect, but no inmediate repair needed 5=comestically excellent, new				
20) What are the primary trip generators for passengers at this bus stop? (Check all that apply) △	Apartments-large complex ☐ Apartments small building ☐ Townhomes ☐ Detached homes ☐ Day-care/pre-school ☐ Gas Station ☐ Government building ☐ Hospital/major Clinic ☐ Hotel ☐		Office Building*/employment* ☐ Park and Ride ☐ Place of Workship ☐ Elementary/Middle School ☐ High School ☐ College/University ☐ Senior Center ☐ Transfer to other bus stop ☐ Transit Station (Hub) ☐		

	Human Service Agency ☐ Library ☐ Major Shopping/employment(*wal-mart, target, mall)* ☐ Entertainment (Bar/Clubs/Pubs/ Movies/Theaters/Restaruants) ☐	Nursing Home ☐ Neighrohood Shopping (*grosery store)* ☐ Other (Specify):_____
21) What pedestrian amenities are at the nearest intersection (or other crossing opportunity)? △	Curb cuts all corners/ both side ☐ Visible crosswalk ☐ Curb cuts at some corners/ one side ☐ Pedestrian crossing signals ☐ Audible crosswalk signal ☐	Accessible Pedestrian Signal ☐ Traffic Light ☐ Crossing guard assistance ☐ Tactile warning strip on curb cut ☐ Other (Specify):_____
22) Are there any problems with the trash receptacles? △	No Trash receptacle* ☐ Trash can very full ☐ Trash can not Securely installed ☐	Dirty and Filthy ☐ No problems with trash receptacle ☐ Other (Specify):_____
***If NO Trash Receptacle please go to question 24 (Section B)**		
23) What is the type of installation for the trash receptacles? △	Attached to the Shelter ☐ Free Standing ☐	Garbage Bag ☐ Bolted to sidewalk ☐ Other (Specify) _____

B. Safety and Security

24) Where is the bus stop located?	In travel lane ☐ Bus lane/pull-off area ☐ Paved Shoulder ☐ No-parking portion of street ☐	In right turn only lane ☐ Unpaved shoulder ☐ Off Street ☐ Other (Specify):_____
25) Are cars parked in either side or between the landing area and the bus stopping area?	Yes ☐ No ☐	
26) Is there any speed limit sign near the bus stop?	Yes ☐ No ☐ Speed Limit in MPH: _____	

27) What are the traffic controls at the nearest intersection? △	Traffic signals ☐ Flashing Lights ☐ Pedestrian Crossing Signal ☐	Crosswalk ☐ Stop/Yield sign ☐ No Traffic controls (None) ☐ Other (Specify):_____
28) Are there any potential traffic hazards? △	No potential traffic hazard ☐ The bus stop is just over the crest of a hill ☐ The bus stop is just after a curve in the road ☐ The bus stop is near an at-grade railroad crossing ☐ Waiting passengers are hidden from view of approaching bus ☐ A stopped bus straddles the crosswalk ☐ Bus stop just before crosswalk ☐ High speed traffic ☐ No crosswalk ☐ Other (Specify):_____	
29) What type of lighting is available? (check at night only) △	No lighting ☐ Street light ☐ Shelter lighting ☐ Outside light on adjacent building ☐	Outside light on adjacent building ☐ Other (Specify)_____
30) Are there any visible payphones?	Yes ☐	No ☐
31) Is the payphone within reach of a wheelchair?	Yes ☐	No ☐
32) Are there any visible police call box?	Yes ☐	No ☐
33) Is the police call box within reach of a wheelchair?	Yes ☐	No ☐
34) What countermeasures are you able to observe in the bus stop? △ (Security features)	No countermeasures (None) ☐ Security and security patrols Design actions ☐ (lighting, plataforms layouts, landing areas, recess wall, good visibily) ☐	Better information (poster, help-line instructions, anti-drug message) ☐ Use of Technology (cameras, emergeny phones ☐
35) Are there any negative environmental attributes or hazards?	Yes ☐	No* ☐
***If NO negative environmental attributes, please go to question 38**		

36) What kind of negative attribute you can observe? △	Suspicious People (Homeless/Drunks/Dealers/Prostitutes) ☐ Broken windows ☐ Dark Alleys ☐ Poor Lighting ☐ Dirty Streets (Trash) ☐ Vacant Store/building ☐ Liquour Stores ☐ Pawn shops ☐ Bushes/Trees limiting visibility ☐	Dark Spots ☐ Motel ☐ Sex Shops ☐ XXX Theaters ☐ XXX Video Stores ☐ Strip Club ☐ Cantinas/Bar/Pub ☐ Billard/Pocker Rooms ☐ Other (Specify):_____
37) Are there problems with the landscaping around the bus stop? △	No Landscaping ☐ No Problems with landscaping ☐ Trees/bushes encroaching on the landing area ☐ Trees and bushes encroaching on the sidewalk ☐ Tree branches that would hit the bus ☐ Poorly maintained/dry ☐ Filty/Dirty ☐ Other (Specify):_____	
38) Is there a bus stop sign?	Yes ☐ No* ☐	
***If NO bus stop sign, please go to the general comments at the end of the questionnaire.**		
39) What information do the sign include? △	Bus Route ☐ Schedule ☐ Connetions ☐	Map ☐ Advertisment/Provider ☐ Other (Specify):_____
40) Are there problems with the signage? △	No problem with signage ☐ Not in eye level of wheelchair ☐ Letters too small/unreadable ☐ Sign in poor condition ☐ Pole in poor condition ☐	Blurry/unclear ☐ Sign not permanetly mounted ☐ Lighting on sign is poor ☐ Sign position hazardous to pedestrians ☐ Other (specify):_____

***General Comments and Observations (attach photograph of the bus stop to the file):**

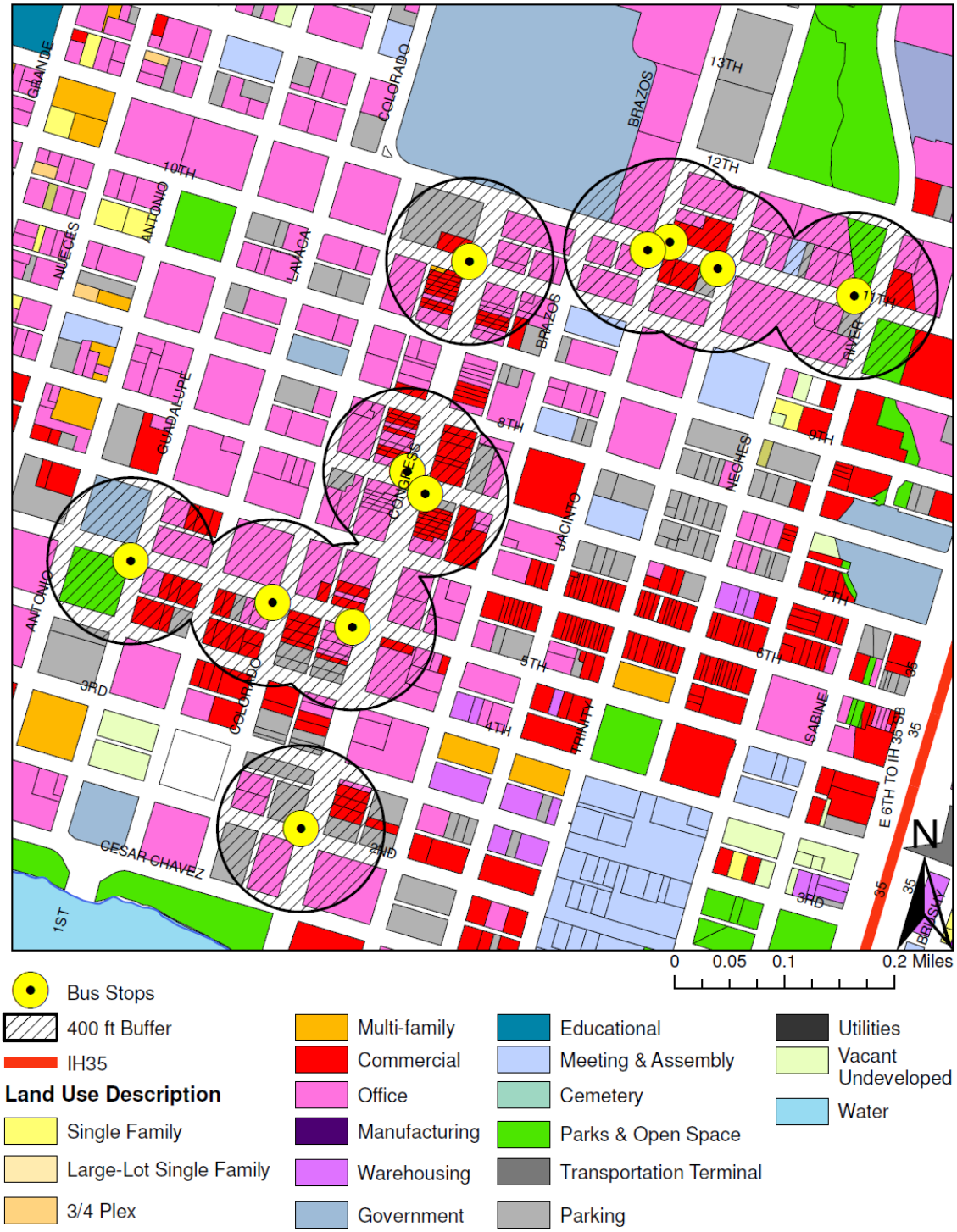
_____

_____

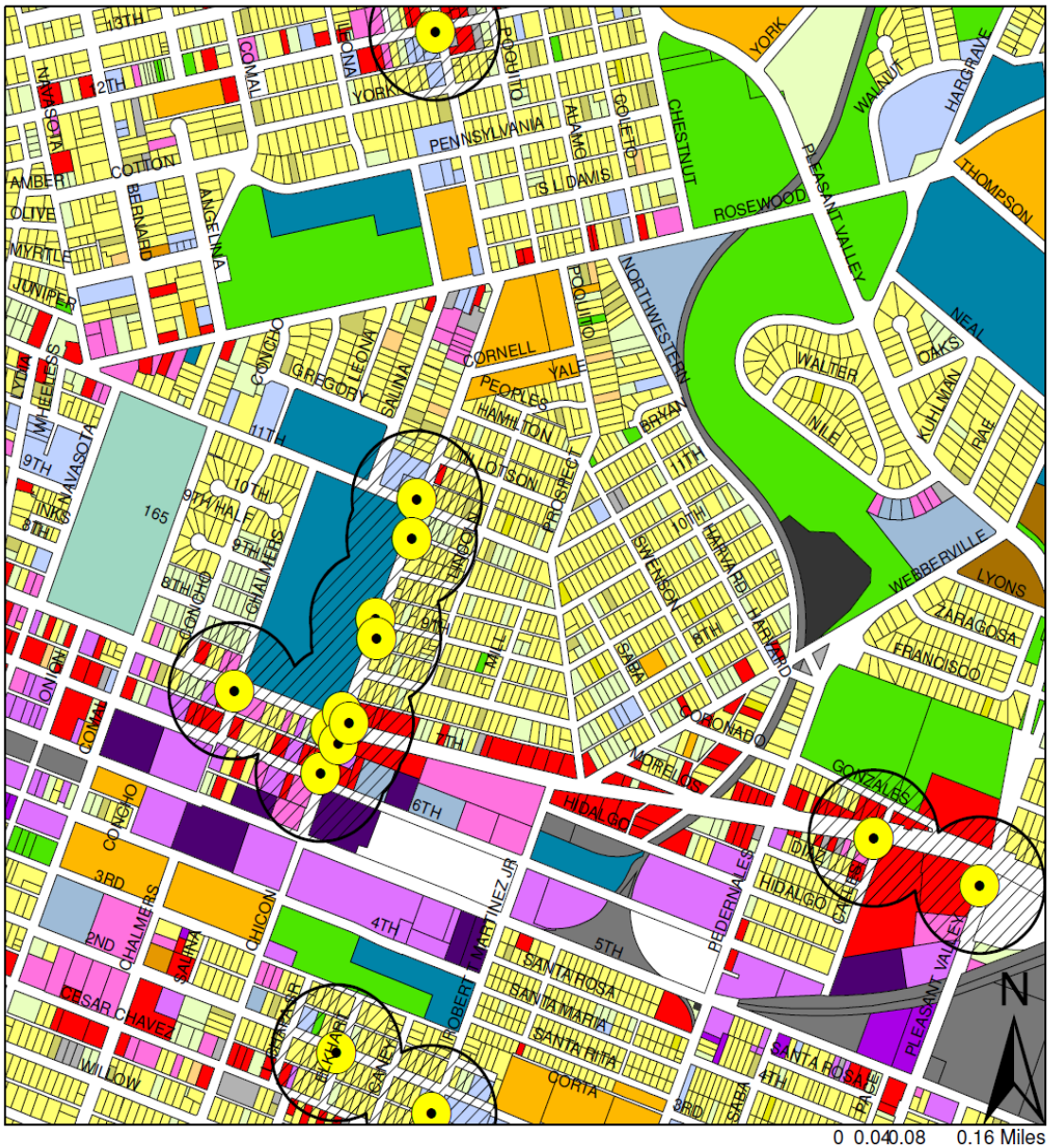
_____

Appendix D: Land Use Maps and Bus Stop Locations

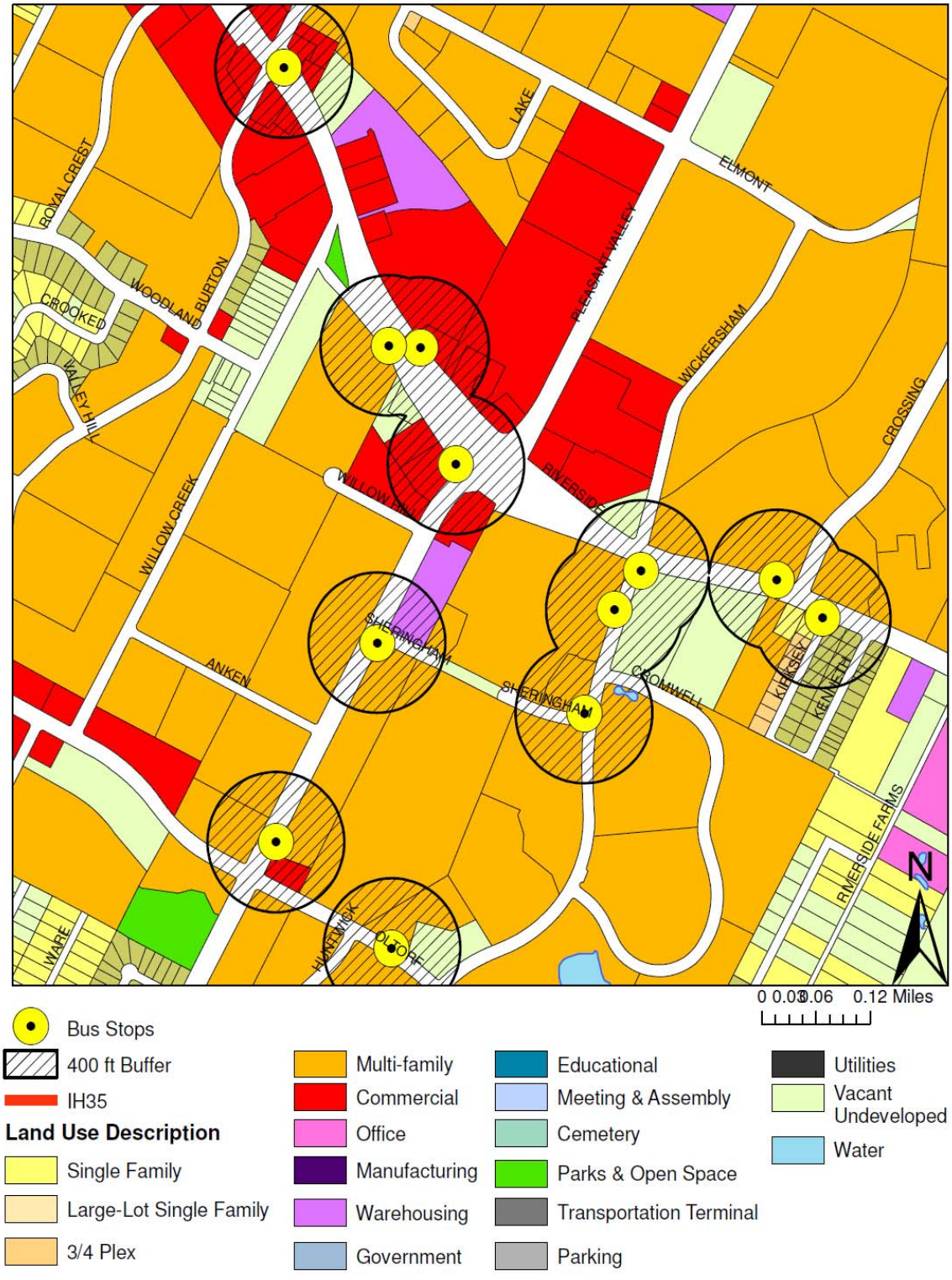
Austin Downtown Area



Huston Tillotson Area



East Riverside Area



Appendix E: Bus Stop Survey Results and Frequency Analysis

FREQUENCIES
Evaluation of Bus Stops (N=38)

TABLE 1 ***Bus Stop Shelters and Seating***		***Frequency and Percentage***		
Bus Stops with Shelter		**Yes =11 (29.0%)**	**No=27 (71.0%)**	
	Shelter Accessible in Wheelchair	Yes=10 (90.9%)	No=1 (9.1%)	
Shelter Damage		**Yes=5 (45.5%)**	**No=6 (54.5%)**	
	Graffiti	Yes=5 (45.5%)	No=6 (54.5%)	
	Broken Panels Roof with Holes Needs Repainting Missing Panels Uneven Floor Other	0 (0%)		
Shelter Condition		**Fair= 2 (18.2%)**	**Good=9 (81.8%)**	
Shelter Orientation		**Facing Towards Street=11 (100%)**		
Seating at Bus Stops		**Yes=27 (71.0%)**	**No=11 (29.0%)**	
Bus Stop Seating Type				
	Bench inside Shelter	10 (26.3%)		
	Freestanding Bench	17 (44.7%)		
Seating Problems		**Yes= 10 (37%)**	**No=17 (63%)**	
	Needs Repainting	Yes=4 (14.8%)	No=23 (85.2%)	
	Filthy and Rusty	Yes=8 (29.6%)	No=19 (70.4%)	
	Graffiti	Yes=1 (3.7%)	No=26 (96.3%)	
	Other	Yes=1 (3.7%)	No=26 (96.3%)	
	Broken Pieces Bushes /Trees Obstructing Seating Seating not securely installed Seating with cracks and holes	0 (0%)		
Seating condition		Fair=9 (33.3%)	Good=11 (40.7%)	Excellent=7 (25.9%)

TABLE 2 *Bus Stop Descriptions*		*Frequency and Percentage*	
Bus Stop Position			
1	Nearside	23 (60.5%)	
2	Mid-block	9 (23.7%)	
3	Farside	6 (15.8%)	
Distance from Previous Bus Stop in Miles			
	0.06	1 (2.6%)	
	0.08	1 (2.6%)	
	0.1	22 (57.9%)	
	0.2	9 (23.7%)	
	0.3	2 (5.3%)	
	0.4	2 (5.3%)	
	0.5	1 (2.6%)	
Has a Companion Bus Stop		Yes=33 (86.8%)	No=5 (13.2%)
Bus Stop Location			
1	In Travel Lane	36 (94.8%)	
2	Pull-off Area	1 (2.6%)	
3	Paved Shoulder	1 (2.6%)	
Posted Speed Limit near Bus Stops		**Yes=5 (13.2%)**	**No=33 (86.8%)**
Cars found parked in Bus Stop Area (incl. Landing Area)		**Yes=12 (31.6%)**	**No=26 (68.4%)**
Bus Stop Signage		Yes=38 (100%)	No=0%
	Bus Route #	38 (100%)	
	Schedule	7 (18.4%)	
	Connections	6 (15.8%)	
	Maps	7 (18.4%)	
	Advertisement	13 (34.2%)	
	Other	1 (2.6%)	
Bus Stop Signage Problems		Yes=10 (26.3%)	No=28 (73.7%)
	Not in Eye level of Wheelchair	1 (2.6%)	
	Letters too small and unreadable	2 (5.3%)	
	Pole in Poor condition	1 (2.6%)	
	Sign with poor lighting/ or poorly illuminated	5 (13.2%)	
	Other	3 (7.9%)	
	Sign in Poor condition Sign Blurry and Unclear Sign no Permanent Mounted Sign position hazard	0 (0%)	

	TABLE 3 *Landing Area and Sidewalk*	*Frequency and Percentage*		
Landing Area		Yes=35 (92.1%)	No=3 (7.9%)	
Landing Area Position				
3	Below Street	32 (91.4%)		
4	Sidewalk	3 (8.6%)		
Landing Area Material				
	Asphalt	1 (2.9%)		
	Concrete	30 (85.7%)		
	Pavers	2 (5.7%)		
	Other	2 (5.7%)		
	Gravel Dirt Grass	0 (0%)		
Landing Area with Problems		**Yes=28 (73.7%)**	**No=10 (26.3%)**	
Landing Area Problems		**Not Accessible**	**Minimal Accessible**	**Accessible**
	Bushes and Trees	0 (0%)	5 (17.9%)	10 (35.7%)
	Wheelchair Mobility	3 (10.7%)	13 (46.4%)	11 (39.3%)
	Uneven Surface	1 (3.6%)	4 (14.3%)	10 (35.7%)
	Slopes Up	0 (0%)	3 (10.7%)	10 (35.7%)
	Slopes Down	0 (0%)	2 (7.1%)	9 (32.1%)
	Stepping over drain inlet	1 (3.6%)	0 (0%)	10 (35.7%)
	Other	1 (3.6%)	1 (3.6%)	2 (7.1%)
Bus Stops with Sidewalk		**Yes=37 (97.4%)**		**No=1 (2.6%)**
Sidewalk with Physical Barriers		**Yes=17 (45.9%)**		**No=20 (54.1%)**
	Electric or Telephone Poles	3 (8.1%)		
	Benches	1 (2.7%)		
	Sewer or Drainage	1 (2.7%)		
	Trees/roots/bushes	7 (18.9%)		
	Traffic Sign	5 (13.5%)		
	Public Phone Box	1 (2.7%)		
	Street Light	4 (10.8%)		
	Other	7 (18.9%)		
	Trash Cans Police Call Box News Stand	0 (0%)		
Condition of Sidewalk				
2	In poor shape	1 (2.7%)		
3	Fair	7 (18.9%)		
4	Good	21 (56.8%)		
5	Excellent / New	8 (21.6%)		

TABLE 4 ***Bus Stop and Pedestrian Amenities***		***Frequency and Percentage***	
Type of Pedestrian Amenities			
	Curb cuts all corners	23 (60.5%)	
	Visible crosswalk	28 (73.7%)	
	Curbs cuts at one side	15 (39.5%)	
	Pedestrian crossing signal	22 (57.9%)	
	Accessible Pedestrian Signal	8 (21.1%)	
	Traffic Light	21 (55.3%)	
	Tactile Warning	2 (5.3%)	
	Audible crosswalk Signal Crossing Guard Other	0 (0%)	
Trash Can		**Yes=28 (73.7%)**	**No=10 (26.3%)**
	Trash Can Full	3 (10.7%)	
	Trash can not secured	0 (0%)	
	Dirty and filthy	2 (7.1%)	
	Problems with trash can	Yes=6 (21.4%)	No=22 (78.6%)
	Other	2 (7.1%)	
Type of Trash Can		Free Standing= 28 (100%)	
Visible Payphones		Yes=5 (12.8%)	No=34 (87.2%)
Payphones Accessible in Wheelchair		Yes=2 (40%)	No=3 (60%)
Visible Police Call Box		Yes=1 (2.6%)	No=38 (97.4%)
Police Call Box accessible in wheelchair		0%	

TABLE 5 *Bus Stop Areas and Adjacent Property Descriptions*	*Frequency and Percentage*	
Bus Stops Adjacent Property Type		
Apartment complex	9 (23.7%)	
Bar and Pub	8 (21.1%)	
Government Bldg	4 (10.5%)	
Human Service Agency	3 (7.9%)	
Mall Shopping	6 (15.8%)	
Office Building	15 (39.5%)	
Other Parking Lot	4 (10.5%)	
Other Restaurant	4 (10.5%)	
Park	1 (2.6%)	
Park and Ride	1 (2.6%)	
Place of Worship	4 (10.5%)	
Residence Townhouse	1 (2.6%)	
Retail Store	9 (23.7%)	
School	6 (15.8%)	
Single Residence	6 (15.8%)	
Supermarket	4 (10.5%)	
Transit Station	3 (7.9%)	
Vacant Lot	6 (15.8%)	
Other	3 (7.9%)	
Daycare Hospital Clinic Industrial Site Library Nursing Home	0 (0%)	
Bus Stop landscape	Yes=23 (60.5%)	No=15 (39.5%)
Bus Stops with Landscape Problems	**Yes=7 (30.4%)**	**No=16 (69.6%)**
Trees Bushes encroaching Landing Area	2 (8.7%)	
Trees Bushes Encroaching Sidewalk	3 (13.0%)	
Tree branches hit the bus	4 (17.4%)	
Poorly maintained and Dry	2 (8.7%)	
Filthy and Dirty	2 (8.7%)	
Other	1 (4.3%)	
Bus Stop Primary Trip Generators		
Apartment complex	9 (23.7%)	
Apartment Small Bldg	7 (18.4%)	
College	8 (21.1%)	
Daycare	1 (2.6%)	
Employment Center	5 (13.2%)	
Entertainment	20 (52.6%)	
Gas Station	4 (10.5%)	
Government Bldg	3 (7.9%)	
Homes	6 (15.8%)	

	Hotel	5 (13.2%)	
	Human Services	2 (5.3%)	
	Neighborhood Grocery	6 (15.8%)	
	Office Building	15 (39.5%)	
	Park and Ride	2 (5.3%)	
	Pharmacy	3 (7.9)	
	Place of Worship	5 (13.2%)	
	Senior Center	1 (2.6%)	
	Townhomes	3 (7.9%)	
	Transfer Bus	8 (21.1%)	
	Other	4 (10.5%)	
	Elementary/Middle School Library High School Hospital/Clinic Nursing Home Transit Hub	0 (0%)	
Bus Stop Area Traffic Controls		**Yes=35 (92.1%)**	**No=3 (7.9%)**
	Traffic Signal	31 (81.6%)	
	Pedestrian Crossing Light	21 (55.3%)	
	Crosswalk	28 (73.7%)	
	Stop/Yield sign	5 (13.2%)	
	Flashing Signal Other	0 (0%)	
Bus Stop Area Traffic Hazards		**Yes=36 (94.7%)**	**No=2 (5.3%)**
	Bus stop over hill	1 (2.8%)	
	Bus stop in curve	1 (2.8%)	
	Waiting Passenger hidden from view	5 (13.9%)	
	Bus Straddles crosswalk	7 (19.4%)	
	Bus Stop before crosswalk	17 (47.2%)	
	High speed traffic	17 (47.2%)	
	No Crosswalk	10 (27.8%)	
	Other	6 (16.7%)	
Bus Stops with lighting		**Yes=37 (97.4%)**	**No=1 (2.6%)**
	Street Light	37 (100%)	
	Shelter Light	0 (0%)	
	Outside Light	7 (18.9%)	
	Other	2 (5.4%)	
Bus Stop Area Countermeasures		**Yes=16 (42.1%)**	**No=22 (57.9%)**
	Design Actions	11 (68.8%)	
	Use of Technology	5 (31.3%)	

	Better Information Security Patrols	0 (0%)	
Bus Stops with negative environmental attributes		**Yes=32 (84.2%)**	**No=6 (15.8%)**
	Types of negative environmental attributes		
	Billiard and Poker Room	1 (3.1%)	
	Liquor Stores	2 (6.3%)	
	Pawn Shop	2 (6.3%)	
	Dirty Streets	4 (12.5%)	
	Other	4 (12.5%)	
	Broken Windows	5 (15.6%)	
	Parking Lot	6 (18.8%)	
	Cantinas Bar and Pub	8 (25.0%)	
	Vacant Stores/lot	10 (31.3%)	
	Suspicious People	12 (37.5%)	
	Poor Lighting	14 (43.8%)	
	Bushes Trees limiting visibility	15 (46.9%)	
	Dark Spots	18 (56.3%)	
	Dark Alley Motel Sex Shops Strip Clubs XXX Theaters XXX Video Stores	0 (0%)	

Appendix F: Bus Stops Cluster Analysis

Cluster: Physical Conditions and Environmental Attributes
Method: Hierarchical Cluster
Variables: 16 Variables and 38 Cases

```
* * * * * * H I E R A R C H I C A L  C L U S T E R  A N A L Y S I S * *
* * *
 Dendrogram using Average Linkage (Between Groups)

                    Rescaled Distance Cluster Combine
  C A S E    0         5        10        15        20        25
  Label  Num  +---------+---------+---------+---------+---------+

          34   -+-----+
          38   -+     +-------+
          12   -------+       I
          36   -+             +---------+
          37   -+-----+       I         I
          33   -+     +-------+         +-----------+
          14   -------+                 I           I
           7   -------------+           I           +-----+
          35   -------------+-----------+           I     I
           4   -------------+                       I     I
          10   -------------------------+-----------+     I
          32   -------------------------+                 I
           9   -------+-------+                         I
          31   -------+       +---------+               +-+
           1   -------------+-+         I               I I
          11   -------------+           +---------+     I I
          18   -+-------------+         I         I     I I
          19   -+             +-----+   I         I     I I
           2   -------+-------+     +---+         I     I I
          23   -------+             I             +-------+ I
          27   --------------------+-+             I       I
          28   --------------------+               I       I
          20   -------------+-----+                 I       +---+
          24   -------------+     +-----------+     I       I   I
          22   --------------------+           +---+       I   I
          21   ---------------------------------+           I   I
          13   -------------+-------+                       I   I
          26   -------------+       +-----+                 I   I
           5   --------------------+-+     +-----+           I   I
          29   --------------------+       I     I           I   I
          16   ----------------------------+     I           I   I
          15   -+-----+                         +-----------+   I
          17   -+     +---------+               I               I
          30   -------+         +---+           I               I
           8   -----------------+   +-----+     I               I
           6   ---------------------+     +-----+               I
           3   ----------------------------+                     I
          25   ---------------------------------------------------+
```

Characteristics of the cluster.
Four (4) types of clusters were identified:

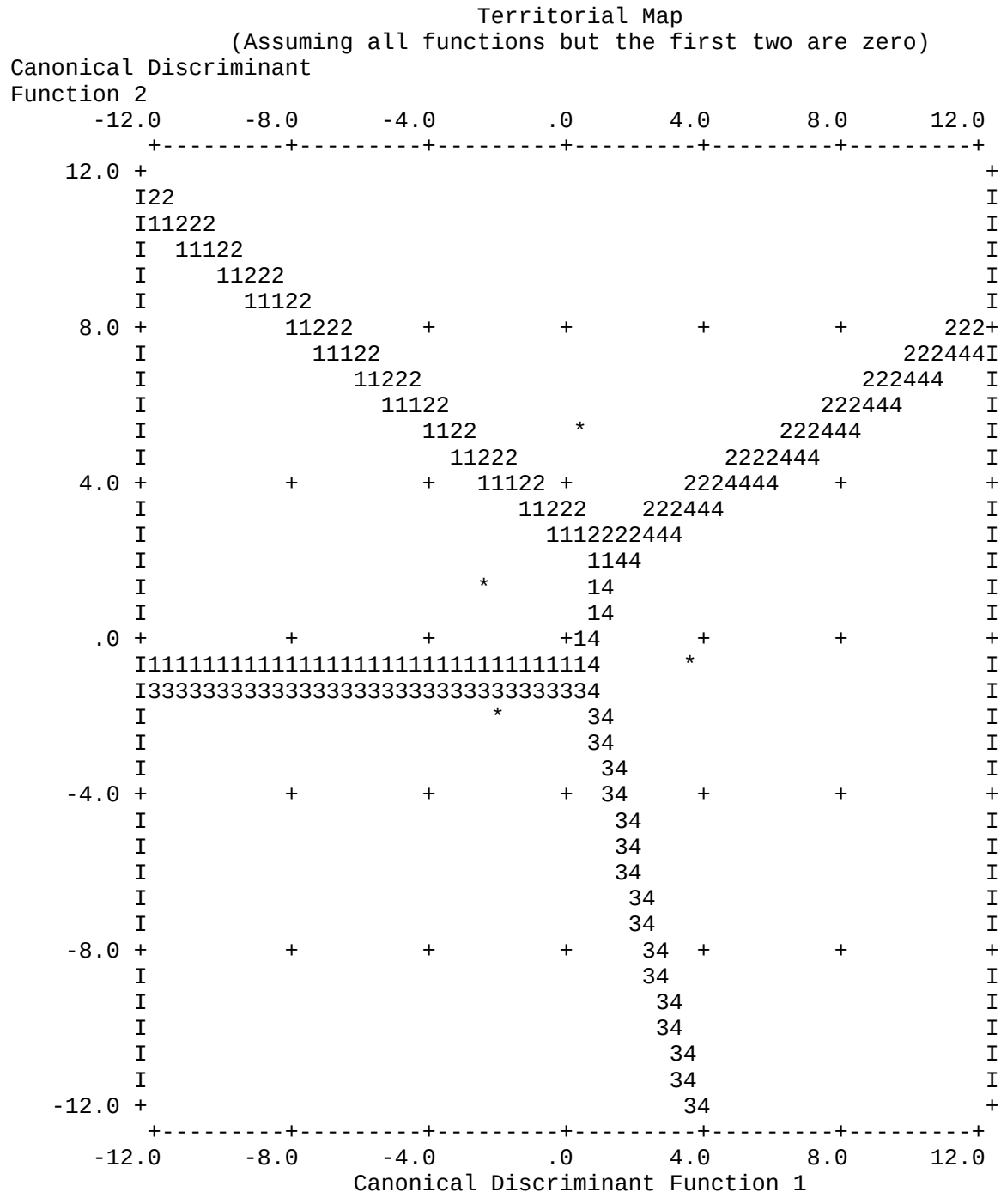
Final Cluster Centers

	Clusters			
	Cluster 1	Cluster 2	Cluster 3	Cluster 4
SHELTER	0	0	0	1
SEATING	3	2	1	2
SIDEWALK	1	1	1	1
POOR LIGHTING	1	1	1	1
SECURITY MEASURES	1	1	1	0
LANDING AREA	1	1	1	1
LANDSCAPE	1	0	1	1
TRAFFIC HAZARDS	1	1	1	1
SUSPICIOUS PEOPLE	1	1	0	0
BROKEN WINDOWS	0	0	0	0
POOR LIGHTING	0	0	0	1
VACANT LOT	0	0	0	0
VISIBILITY	0	1	0	1
DARK SPOTS	0	1	0	1
CANTINAS /BAR/PUBS	0	1	0	0
PARKING LOT	0	1	0	0

1, 2, 3= variables selected
0= variable not selected

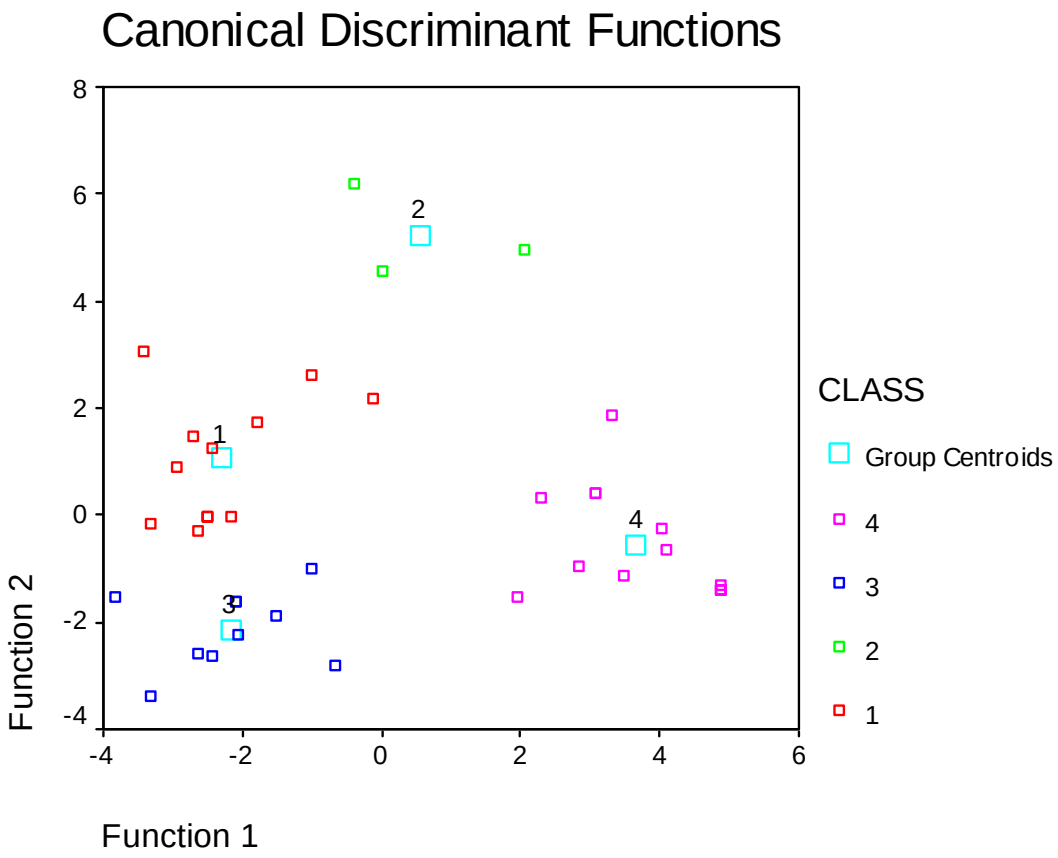
Cluster Membership

Case Number	Cluster	Distance
1	1	1.541
2	1	1.173
3	3	1.658
4	4	1.449
5	3	1.718
6	3	1.533
7	4	1.395
8	3	1.323
9	1	1.173
10	4	1.717
11	1	1.307
12	4	1.449
13	4	1.552
14	4	.933
15	3	1.072
16	3	1.533
17	3	1.072
18	1	1.021
19	1	1.021
20	2	1.155
21	1	1.791
22	1	1.646
23	1	1.369
24	2	.816
25	2	1.414
26	3	1.245
27	1	1.429
28	1	1.307
29	3	1.597
30	3	.975
31	1	1.021
32	4	2.081
33	4	.697
34	4	1.250
35	4	1.552
36	4	.697
37	4	.697
38	4	1.250


Territorial Map
(Assuming all functions but the first two are zero)
Canonical Discriminant
Function 2
-12.0 -8.0 -4.0 .0 4.0 8.0 12.0
12.0
8.0
4.0
.0
-4.0
-8.0
-12.0
Canonical Discriminant Function 1

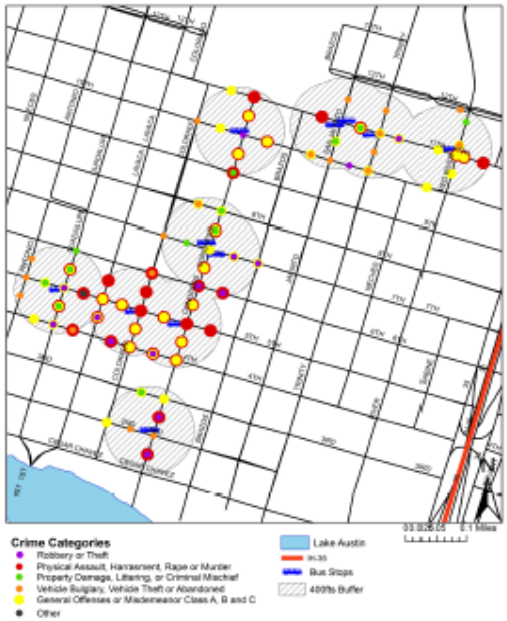
Symbols used in territorial map

Symbol	Group	Label
1	1	
2	2	
3	3	
4	4	
*		Indicates a group centroid



Appendix G: Bus Stop Crime Incidents

Crime Incidents in Austin Downtown Area



AUSTIN DOWNTOWN AREA

Downtown area shows the highest spatial concentration of Type I crimes or serious crimes. Most of the crimes recorded are physical assaults, harassments, rape, theft, robbery by assault, aggravated robbery, purse snatching, and shoplifting. Although the data provided by Austin Police Department include incidents of murder and homicide, none of these crimes were reported in downtown area. The data revealed that serious crimes seems to be spatially clustered between 6th street to 4th Street and Guadalupe Street to Congress Street; all along Congress Street to be precise. These data is congruent with HT focus groups observations on hotspots in downtown area and outline their perception of safety with real incidents and context of crime.

Also, downtown area reported the highest concentration of general offenses and misdemeanors. The data presented shows a primary spatial concentration of general offenses all along Congress Street, Guadalupe Street and Colorado Street, and between 4th Street to 6th Street. Trinity Street, 11th Street, San Antonio Street, and 2nd Street have a land use characterized by parking lots, parking garages, and parking open spaces. Thus, it is rational that most of the vehicle burglary or theft are clustered and outlying around these four areas.

Crime Incidents in Huston Tillotson University Area

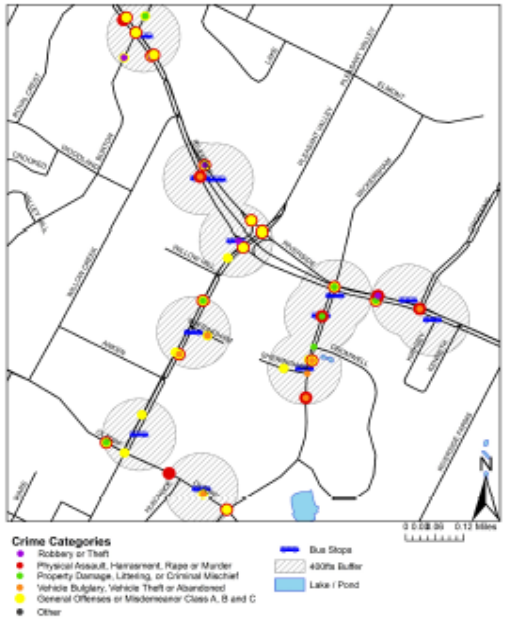
HUSTON TILLOTSON UNIVERSITY AREA

HT Area shows a high concentration of Type I or serious crimes. The data revealed an spatial cluster of physical assault related crimes around 12th Street-Chicon bus stop and 7th Street-Pleasant Valley Road. The rest of the serious crimes are mainly robbery and theft related crimes, including robbery by assault, aggravated robbery, and purse snatching. Theft crimes are spatially clustered along Chicon Street and along 7th street. A few incidents of robbery were reported between 2nd and 3rd Street on East of Chicon Street, but not enough as to be considered a cluster.

On the other hand, Austin Police Department does reported a murder in the HT Area within the bus stop buffer zone of 7th Street and Pleasant Valley. In addition, there are not many shoplifting crimes since the land use indicates it is a single family/residential area for the most part.

Regarding general offenses and misdemeanors (Class A, B, or C), Huston Tillotson Area also show a high spatial concentration of these types of crimes, particularly along 7th Street corridor and Chicon Street.

Crime Incidents in East Riverside Area

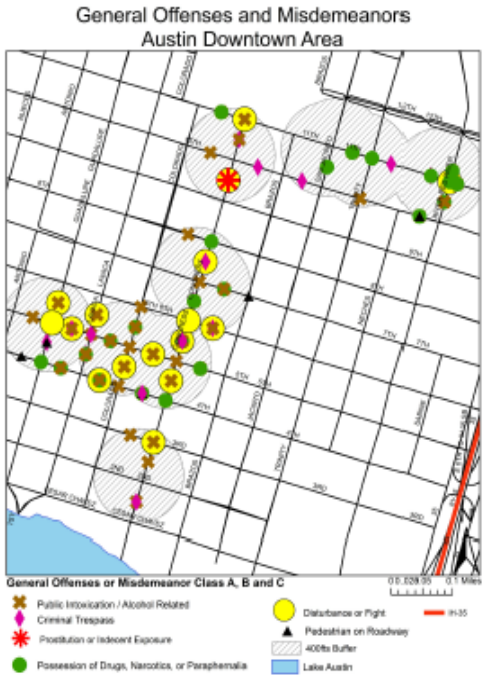


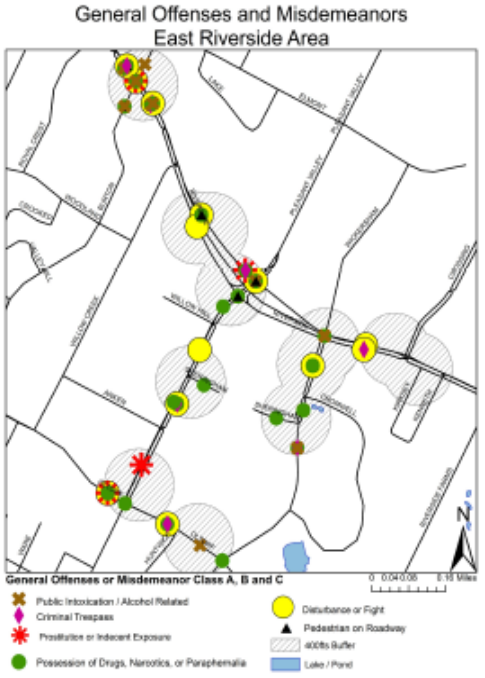
EAST RIVERSIDE AREA

East Riverside Area has a moderate-low spatial concentration of crime around the surveyed bus stops. Physical assault related crimes are present at almost every bus stop location. The corner of Wickersham and East Riverside Drive does report having a murder. In general, most of the crimes incidents are concentrated along the four major arterials that border the study area: Pleasant Valley Road, Oltorf Street, Wickersham Lane, and East Riverside Drive.

As a patter, General Offenses and misdemeanors seem to be primarily located along Pleasant Valley corridor. Property Damage, littering and criminal mischief related crimes seem to be spatially clustered within the corner of Wickersham Lane and East Riverside Drive. This corner can be considered a hotspot for transit crime. This finding is congruent with the land use of the area which reported several vacant lots in that corner and along Wickersham Lane. Thus, setting the proper conditions for crime to occur.

Appendix H: Bus Stops General Offenses





AUSTIN DOWNTOWN AREA

Downtown area shows the highest spatial concentration of general offenses and misdemeanors from the three study areas. The data reveal an spatial cluster of disturbances and fights, public intoxication, and drug related offenses between 4th Street and 6th Street and Guadalupe Street to Congress Street. These same crimes seem to be present throughout Congress Street. Colorado Street and 6th Street bus stops reported the highest public intoxication incidents from all the surveyed bus stops.

In addition, Congress Street reported one crime incident related to prostitution or promotion of prostitution near 11th Street. 11th Street bus stops present a spatial concentration of drug related offenses, particularly from San Jacinto Street to Red River Street Intersections.

HUSTON TILLOTSON UNIVERSITY AREA

Huston Tillotson Area also show a high spatial concentration of drug related offenses, particularly along 7th Street corridor and Chicon Street. The intersection between Chicon Street and 12th Street shows a particular cluster of drug possession offenses, and public intoxication. Three prostitution incidents were reported in Chicon Street: one near 12th Street intersection, and the remaining two, right across Huston Tillotson University campus (near the 11th Street intersection).

Data reveal a small cluster of drug possession and public intoxication offenses between the 2nd Street and Robert Martinez intersection. In addition, 7th Street and Pleasant Valley intersection shows a small cluster of criminal trespass related offenses.

EAST RIVERSIDE AREA

East Riverside Area has a moderate-low spatial concentration of general offenses and misdemeanors around the surveyed bus stops. Civil disturbances offenses are present along the four major arterials: East Riverside, Pleasant Valley, Wickersham ,and Oltorf. Prostitution offenses are present in Pleasant Valley and particularly prominent near Oltorf intersection.

In contrast to the rest of the study areas, pedestrian on roadway offenses are recurrent in Riverside, particularly along East Riverside corridor. East Riverside Drive also shows a concentration of public intoxication offenses. Drug related crimes are mostly present around Pleasant Valley bus stops and with a few incidents near Wickersham bus stops.

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Vita

Ana Julita Gomez-Sanchez was born and raised in Panama City, Republic of Panama. She attended Florida State University, graduating with a Bachelor of Science in Political Science and International Affairs. Upon graduation Ana moved to Madrid, Spain to begin studying for a Master in Latin American Studies at the Complutense University of Madrid. Concurrently she began working at the Embassy of Panama in Madrid as a Program Associate for the office of International Cooperation. After graduating Ana went back to Panama to work as a Technical Consultant for the United Nations Development Program (UNDP) and the Panamanian Ministry of Economic and Finances (MEF). At UNDP / MEF, she co-led the project "*Restructure of the International Cooperation for Development in Panama"* and participated in multiple task forces for projects related to social development. Upon the end of her tenure, Ana decided to take the position of Project Coordinator with the National Secretariat of Science, Technology, and Innovation of Panama (SENACYT). At SENACYT she was able to develop and implement a variety of projects at national and international levels. In 2008, Ana was granted a full scholarship award by the Organization of American States (OAS) and returned to United States to pursue a Masters Degree in Community and Regional Planning at The University of Texas in Austin. Her coursework covered a wide range of areas but she concentrated on Transportation and Environmental Planning. Ana completed her Master's degree at The University of Texas in Austin in August 2010.

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